SIXTY-SEVENTH YEAR

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THOMAS A. EDISON AND HIS IMPROVED STORAGE BATTERY

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SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record, accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

The Death Roll of the Aeroplane

THE shocking list of fatalities to airmen, ending with the tragic death of Hoxsey and Moisant at the very close of the year, has sent a thrill of horror throughout the civilized world. Doubtless it will lead many people to ask whether the risks of the new and fascinating art are not so great as to raise doubts both as to its utility and permanence. For ourselves, we believe that nothing has occurred that warrants our losing faith, either in the usefulness of the new art, or in its permanent hold upon public sympathy and interest. The thirty or more deaths which have occurred, considered by themselves, represent a terrible toll taken by the laws of Nature on those who have so boldly ventured into the hitherto inaccessible ocean of the air. Yet, we must not forget that if the increase in the number of accidents has been great, it is not out of proportion to the great increase which has taken place in the ranks of the practical aviators. Indeed, an estimate that has been made in one of the French papers devoted to aviation shows that the ratio of accidents to the number of people engaged in flying, was considerably less this year than it was in the year preceding.

As regards the future, we believe that the proportion of accidents will materially decrease, and this for several reasons. In the first place, the builders and users of aeroplanes make every effort to ascertain the details of all serious accidents that occur and determine their causes, whether they lay in the faulty construction of the machine, or in the lack of skill or the over-daring of its manipulator. It is probable that every accident yields its quota of valuable lessons for guidance in future construction and future handling.

The same French authority, after making a careful investigation of the accidents of last year, has concluded that only a small percentage was due to defects in the machines—an opinion in which we are inclined to concur. At the same time, there is no doubt whatever that with a few exceptions, the majority of aeroplanes are built with too slight a margin of safety of strength in their various parts. We pointed out recently, in our article on "The Racing Aeroplane of the Future," that by the use of high-grade steel alloys, of high elastic strength and great toughness, it would be possible, without any increase of weights, to build a flying machine that would be strong enough to resist, not merely the ordinary stresses which occur in straightaway flying, but the abnormal stresses to which the machine is subjected in stormy weather, and when the aviator is making those spectacular dives and other attractive maneuvers which have become so popular with the race-going public.

With a few exceptions, the machines which are in use at the present time cannot be said to have been designed by men who possess the theoretical knowledge which is necessary in the planning and construction of these delicate and unusual mechanisms. The new art, however, has now reached a stage of popularity at which it has become commercially attractive. Capital is not only available, but is positively eager to lend itself to the exploitation of the flying machine; and skilled engineers are being attracted in increasing numbers to the new industry, which is at a stage where it can afford to employ the best engineering talent.

A disconcerting feature of last year's death roll is that it includes so many of the most skilled among the airmen. This fact might seem to suggest that we have not advanced as far as was supposed in our understanding of the conditions that govern the flight of heavier-than-air machines. On the other hand, it should be remembered that many if not most of the accidents have occurred when the airmen were attempting spectacular performances for the entertainment of the race-going public or to win large money prizes. There can be no doubt that this spirit of daring has been carried altogether too far; and it is to be hoped that the lesson of caution which has been taught with such tragic significance will not be lost.

Although the consensus of opinion among aviators seems, at the present writing, to be against the use of automatic control, we still believe that the perfected machine of the future will embody this feature, and that it will be of such a flexible character as to leave the operator with manual control of his machine at all times, and yet be capable of preventing such complete loss of equilibrium as seems to have occurred in the case of Johnstone, Hoxsey, and Moisant. We are inclined to think that the combined use of the dihedral angle in the main surfaces and the gyroscope will provide the aeroplane of the future with a self-righting ability similar to that shown by the birds of the air, when they are accidentally capsized.

Producer Gas Engines for Marine Use

A COMPARATIVELY new departure in marine engineering is the equipment of vessels with producer gas engines. As yet the number of such installations can be counted on the fingers of one's hands; but the indications are that this system is destined shortly to find very extended use. It is therefore with particular interest that we note a paper recently delivered before the Society of Naval Architects and Marine Engineers by C. B. Page, on "Marine Installations of Producer Gas." Much valuable information is contained in this paper. Some of the advantages of the system are clearly brought out by figures cited with reference to the "Mary A. Sharp," a boat plying on Chesapeake Bay, and equipped with a producer gas engine. The fuel consumption is remarkably low, 1.13 pounds per indicated horse-power. The average indicated horse-power during an actual trip was 60.8, yet the engine with its producer is contained in a room measuring but 13 feet 3 inches in length. The weight of the engine is 9,500 pounds, that of the producer 6,000 pounds, thus giving a total weight per indicated brake horse-power of 205 pounds. The producer has a cylindrical steel shell lined with asbestos and fire-brick. In operation it is quite warm to the touch, but not excessively hot. The gas is drawn from the producer by the suction of the engine, so that the former is always at reduced pressure, and there is no possibility of leakage of the poisonous gas into the engine-room.

In land practice it is customary to introduce water into the producer, for the double purpose of enriching the gas (by the formation of water-gas) and of softening the clinker. Attempts to use this same expedient with marine producers have proved futile, owing to the deposition of salt and the effect of the motion of the vessel upon the water vaporizer. Experience, however, seems to show that the presence of any considerable proportion of water-gas is harmful rather than beneficial, while the softening of the clinker is satisfactorily accomplished by introducing exhaust gas from the engine under the grate. A small amount of water is run into the ash-pit to keep the ashes and the bottom of the producer cool. The trifling quantity of steam thus introduced into the producer assists in keeping down the clinkers. It is considered that the grate should last two years, and the fire-brick lining from three to five years. The fire, after it is once started, can be maintained for months without interruption, and the producer worked continuously. The operation of removing the ashes and poking down the clinker does not seriously affect the quality of the gas, and can therefore be carried out without shutting down the engine, and while the latter is in full working. The engine is of the two-cycle type, and combines the compactness and simplicity characteristic of this type, with an efficiency ordinarily associated with four-cycle working. This is rendered possible by the fact that in marine work the engine runs practically at full load throughout, and it is known from land practice that under these conditions a two-cycle engine can be run with good economy. The engine has a number of detail features, which render it peculiarly adapted for the particular field for which it is intended. All in all, one is left with the impression that a marked step forward has been made in a direction which bids fair to lead to important developments of great practical value.

The New York Aviation Show

WHAT the New York Aviation Show may have lacked in size it gained in the general excellence of the exhibits and the fact that the whole display, with the exception of the exhibits of a Bleriot and a Demoiselle machine, was distinctively American. Furthermore, it is an encouraging fact that at this comparatively early stage, an exhibition of this character should be so singularly free from machines of what has come to be generically termed the "freak" type. In all of the aeroplanes which were exhibited, there was evidence of intelligent design and careful and generally high class workmanship.

The Wright brothers were represented by two machines, one of the standard type, with 39-foot by 6-foot sustaining surfaces, driven by a 30 to 35-horse-power Wright engine. This machine was beautifully finished throughout, and revealed none of that general roughness of construction which was a matter of frequent comment in earlier Wright biplanes.

The other machine was a "Baby" Wright, with sustaining surfaces 26½ feet by 3½ feet and a total area of 185 square feet, driven by a 35-horse-power engine at a speed of nearly 60 miles an hour. This flyer has done some particularly good altitude work, having attained at Belmont Park an elevation of 9,714 feet. It has a climbing speed of 500 feet per minute.

A stand which attracted considerable interest was that of the Flyers Club, which exhibited an interesting group of models, made chiefly by the younger members among the aeronautical enthusiasts. In the next stand was a biplane of the Curtiss type built by C. and A. Wittemann of Staten Island, in which were several new and excellent features. The sustaining surfaces, 28 by 5 feet with a lifting area of 280 square feet, were set at the slight dihedral angle of 3 degrees. Spruce has been adopted in place of bamboo, as being lighter, and the total weight of the machine has been kept down to 550 pounds. The front and rear control are connected. Both the horizontal and vertical rudders are operated by a rocking shaft. The chassis is mounted upon three wheels, all of which have spiral spring vertical shock absorbers, while the two mainwheels beneath the body of the machine have spring-controlled lateral play.

The Walden-Dyott monoplane, shown in the adjoining stand, has the distinction of being the first American monoplane to make a successful flight. Its wing surface, 26½ feet by 7 feet, has a total area of 162 square feet. The machine is driven by a 25 H. P. 3-cylinder Anzani motor of the model used by Bleriot in his cross-channel flight. The weight of the machine, without operator and fuel, is 420 pounds. A novel feature of this machine is the provision at the tip of each wing of a stabilizer, consisting of a small plane surface set at an angle laterally of about 45 degrees to the wings, the theory being that the stabilizer on the depressed side presents an increasing reaction, while that on the opposite side has a decreasing reaction as the machine rolls out of the horizontal position.

The fact that Grahame-White has placed an order for seven machines, one for use in England and six for service in his training school to be established in New England, lends particular interest to the two biplanes exhibited by Burgess and Curtis. The two-passenger machine ordered by Grahame-White is driven by an 8-cylinder, 65-horse-power Indian motor-type engine at a maximum speed of 48 miles per hour. It is of the general Farman type and weighs about 1,000 pounds in flying condition. The front and rear controls are connected, and an interesting novelty is the use of small plane surfaces on the wing tips which can be thrown into the vertical position to retard the inner wing tip when the machine is turning.

In the following stands. are Moisant's Bleriot, in which he flew from Paris to London, the Demoiselle, which was flown at Belmont Park, and an 8-cylinder, 50-horse-power standard Curtiss biplane.

The Aeronautical Society, which has done such splendid work in promoting aviation in this country, was represented by a stand in which was exhibited a fine group of aeroplane models. The Society has a membership of 500, and already 43 members have built full-size aeroplanes, 28 of which have flown. A machine deserving especial notice for its fine workmanship was that exhibited by the Volanaut Construction Company. It is of the Curtiss type, with 216 feet of supporting surface, and is driven by a 50-horse-power water-cooled motor with four cylinders cast in block.

Glenn Curtiss Wins the Scientific American Trophy

The First Aeronautical Trophy to be Offered for Competition in America

BY winning for the third time the SCIENTIFIC AMERICAN Trophy for the longest cross country flight of the year, Glenn Curtiss becomes the permanent owner of a prize whose value will appreciate as the years pass on. Inasmuch as this was the first prize of any kind offered in America in connection with the new art of flying, the trophy must always stand in a class by itself, and we congratulate Mr. Curtiss on the fact that, among the prizes which he has taken, is included one of such unique distinction as this.

In the year 1907, when the publishers of the SCIENTIFIC AMERICAN announced the offer of this trophy, the art of flying was yet in its infancy; and this in spite of the fact that the Wright brothers, some years before, had made their wonderful demonstration at their home town of Dayton, Ohio. Outside of those performances, practically nothing had been accomplished in the country where mechanical flight had had its birth. The French people, with their usual alertness and enthusiasm, had been quick to appreciate the significance of what the Wrights had done, and were busily engaged in the attempt to repeat their performances, and, if possible, better them; but America, strange to relate, was exhibiting an astonishing lack of appreciation of the epoch-making achievements of their fellow countrymen.

It was in the hope of awakening an interest in the flying machine and stimulating our inventors and manufacturers to take hold of the new art and assist in its successful development, that the SCIENTIFIC AMERICAN decided to offer for competition the silver trophy, an illustration of which is given herewith. The deed of gift by which it was transferred to the keeping of the Aero Club of America, called for annual competition by heavier-than-air machines, with the understanding that the conditions governing the contest were to be changed from time to time, so that they would keep pace with the progress made in the art of flying. The conditions laid down for the first year seem to us remarkably easy in this day of great accomplishment. The competitors were required to make a straightaway flight of one kilometer (0.621 mile) in a straight line. On July 4th, 1908, Mr. Glenn Curtiss won the trophy for that year by flying for a distance of slightly more than a mile in his new biplane, the "June Bug." During the following year, such remarkable progress was being made by the French aviators, that the conditions of competition for the year 1909 were made more severe, and the competitors were required to cover 25 kilometers (15½ miles) in a closed circuit, that is to say, the course was 5 kilometers (3.1 miles) longer than that required in the international contest for the Gordon-Bennett trophy. This was the minimum distance that the competitor must cover in order to win the trophy, which was to be awarded to the aviator who made the fastest and best flight in a closed circuit during that year. Curtiss was the only competitor to enter the contest, and he established his claim upon the cup for a second time by flying over a closed circuit on Long Island for double the distance required in the Bennett cup race. The third and last successful effort of Curtiss to win the cup was made in connection with his great flight from Albany down the Hudson River valley to New York, when he covered a straightaway distance from Albany to Poughkeepsie of 74¼ miles, without a stop. This flight was made in June, and in view of the excellent work which was being done by various American aviators, it was the expectation of the SCIENTIFIC AMERICAN that other competitors would enter for the cup. In this, however, we have been disappointed, and Mr. Curtiss's flight from Albany to Poughkeepsie entitles him to inscribe his name on the trophy for the third time, and thus become the permanent winner thereof.

It is a matter of great regret to us, as indeed it must be to all who are interested in promoting aviation in this country, that upon every occasion the cup was won without any competition. In 1908 and to a less degree in 1909, this indifference was excusable for the reason that outside of Curtiss and the Wright brothers, there were no aviators who were sufficiently skilled to compete with any prospect of success. During the past year, however, progress in flying in America has been rapid, and there were several aviators possessed of good machines, who could have entered for the cup with more than an even chance of surpassing Mr. Curtiss's flight of 74¼ miles. The fact that no entries were made proves that there has been a decadence of the true sporting spirit, competitors preferring to enter contests in connection with which large cash prizes were offered. Outside of the intrinsic value of the SCIENTIFIC AMERICAN Trophy, which is not inconsiderable, there was no inducement to incur the trouble and expense of trying for a cross-country record, other than that of the distinction which was conferred on the successful competitor; and the fact that the winning of the first trophy of any kind offered in this country should have so signally failed to appeal to American aviators, certainly indicates a lack of the true sporting instinct, and proves that the game is governed by the professional, as distinct from the true amateur spirit.

In view of these facts, we feel that no little credit attaches to Mr. Curtiss, who has always evinced the greatest interest in the competition, and who, if successful competitors had come forward, would undoubtedly have put up a strong fight to retain the trophy.

SCIENTIFIC AMERICAN TROPHY
Won in 1908, 1909, and 1910 by Glenn H. Curtiss.

GLENN H. CURTISS, THE WINNER OF THE SCIENTIFIC AMERICAN AERONAUTICAL TROPHY Photo by Levick.

Frischauer, working in Mme. Curie's radiological institute, has discovered that the rays emitted by strong radium preparations have the power to induce crystallization in supersaturated solutions and in liquids cooled below the normal temperature of solidification. In both of these classes of "metastable" liquids, the incidence of radium rays is equivalent in effect to the addition of a minute crystal of the dissolved or fused substance.

The occurrence of something resembling disease in metals was discovered a few years ago. Tinware is often found spotted with an amorphous gray powder. This condition has appropriately been called the tin pest, for it is contagious. Unspotted tinware, placed in contact with this powder at a favorable temperature, becomes infected, and the tin plating slowly crumbles to dust. The spontaneous occurrence of the pest has been observed only in very old tinware, but Frischauer has discovered that the disease is quickly produced in new tin vessels by the rays emitted by radium.

All of these phenomena can be explained by the assumption that the substances are in a state of unstable equilibrium, like a wagon on the brink of a precipice. It needs but a slight push to send the wagon to the bottom, and only a small impulse is required to crystallize the metastable liquids, or to convert the tin into the amorphous condition, into which it has a tendency to pass. According to a theory propounded by Mme. Curie and Prof. Lippmann, this impulse is given by the impact of the electric particles projected by radium. The plausibility of this hypothesis is increased by Frischauer's discovery that no similar effect is produced by Roentgen rays, which do not contain electric particles.

The Metropolitan Railway is trying experimentally a new type of car. The corridor principle is adopted in the new coaches, which have three spacious compartments, with a door to each and a central gangway running the whole length. On either side of the gangway in each section seats are provided for four passengers, two a side, while the seat at either end of the compartment can accommodate six people if the emergencies of the traffic require, making twenty-eight seats altogether in the coach. Two trains are to be used for the experiment. They will be run between Liverpool Street and Chesham and Aylesbury. To Harrow electric traction will be used; beyond Harrow steam engines will be employed. Some compartment stock is already run by the Metropolitan in its through trains between the City and the Aylesbury and Chesham lines, and a strong preference is shown for it by many regular travelers, who make up parties. If the results of the experiment are satisfactory, more of these trains will be built.

Thomas A. Edison's Latest Invention

A Storage Battery Designed and Constructed from the Automobile User's Point of View

By Joseph B. Baker, E.E.

For over a decade, Thomas A. Edison has been working to produce a type of storage battery better than the old lead type. At last he has succeeded. His new cells are now in actual commercial use. In the following article the reader will find a description of the new battery, written after a painstaking study of its manufacture.

LD, indeed, is the idea of the commercial storage battery. Lead plates were immersed in an acid electrolyte, by Gaston Planté in 1861. Emile Faure brought out the pasted-plate battery in 1879, and Charles F. Brush in 1881 introduced improvements which made the lead battery a factor in electric vehicle work, producing a cell which would give eight watts of electric power per pound of material. From these early beginnings, many inventors have sought to increase the electrical efficiency, and the durability or "life" of the cell, and reduce the cost of manufacture.

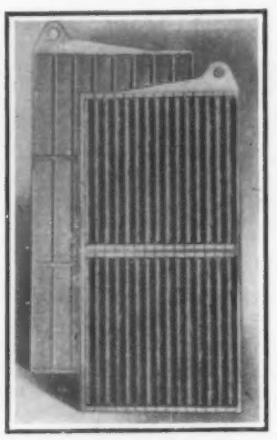
It was in the early eighties that the public began to think about "stored electricity" which could be bought by the can, as it were, like any other commodity. This dream has come true in the new Edison nickel-iron storage cell. Stored electricity finds its greatest usefulness in propelling cars and road vehicles, and it has been for this application, primarily, that the Edison storage battery has been developed. The need of the electric vehicle was recognized by Mr. Edison nine years ago. He saw that there are two viewpoints: that of the electrical man with his instruments, his rules for efficient operation and reasonable life of the battery, his absolute knowledge that the same care should be given a vehicle battery that is given a valued horse or even a railroad locomotive; and that of the automobile driver, who simply wishes to go somewhere with his car, and who, when he arrives somewhere, wishes to go back. And in this long-promised battery the highly practical nature of Mr. Edison's work is once more exemplified in that he has held uncompromisingly to the automobilist's point of view. The fact to be faced, he realized, is that the electric vehicle user will work his car to the utmost, and will be limited only by repairs and breakdowns; just as the average gasoline car driver has always operated his car to the limit of repairs and breakdowns. How well he has succeeded in aligning his battery to this ideal, the automobile driver will appreciate from the figures of actual performance that are now available. A recent average of 144.35 miles on a single charge was made in a family-type electric vehicle equipped with the new battery. This figure is the average of four trips, each with New York city (Manhattan) as the starting point. The longest of these trips, 172.1 miles, was to Babylon, Long Island, by way of Mineola and Plainview, returning by the southerly route through Massapequa and Freeport. The map distance by this route is 90.9 miles, and 81.2 miles additional was covered after the regular run, the average speed being 10.93 miles per hour.

The original Edison storage battery, known as the type E, was put out about seven years ago. The type E cell marked a definite step in invention, in that it proved the commercial success of a wholly new voltaic combination, a radical departure from the lead plates in an acid electrolyte. Believing that the lead cell had too many inherent weaknesses to realize the full promise of "stored electricity" as a motive power for vehicles, Mr. Edison had set his staff to work on an entirely new line, and the outcome was a nickel-iron element immersed in an alkaline electrolyte, lighter and cleaner than the lead cell, with lower cost of operation and upkeep to offset its higher initial cost, and possessing hitherto unheard-of properties of remaining undeteriorated either by overcharging or being left uncharged. These were the very qualities demanded by the automobile user. The cell developed certain weaknesses in service, which caused the inventor to withdraw it from the market and resume experiments to improve the form of the voltaic combination, in order to obtain better electrical properties and a longer life. The new series of experiments lasted four years, and resulted in the present commercial Edison cell, known as the type A. This cell is now being actively marketed for electric vehicle work in three sizes, the A-4, A-6, and A-8 cells, having respectively 4, 6, and 8 positive plates and 5, 7, and 9 negative plates, the two outside plates of the element being negatives. The normal discharge voltage is 1.2, and a battery is regarded as completely discharged when it shows an average of 1.0 volt per cell. In each size the dimensions of the individual

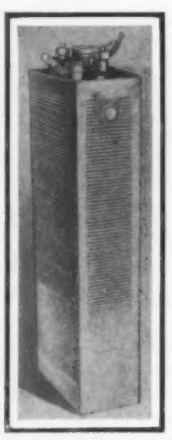
(*Continued on page 45.*)

A storage battery omnibus. Mr. Edison is in the front seat.

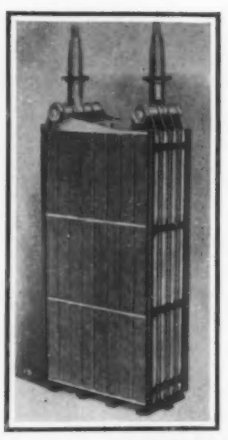
Interior of type 4-A Edison cell and cover of can with terminal stuffing box, gas valve, and filling aperture.



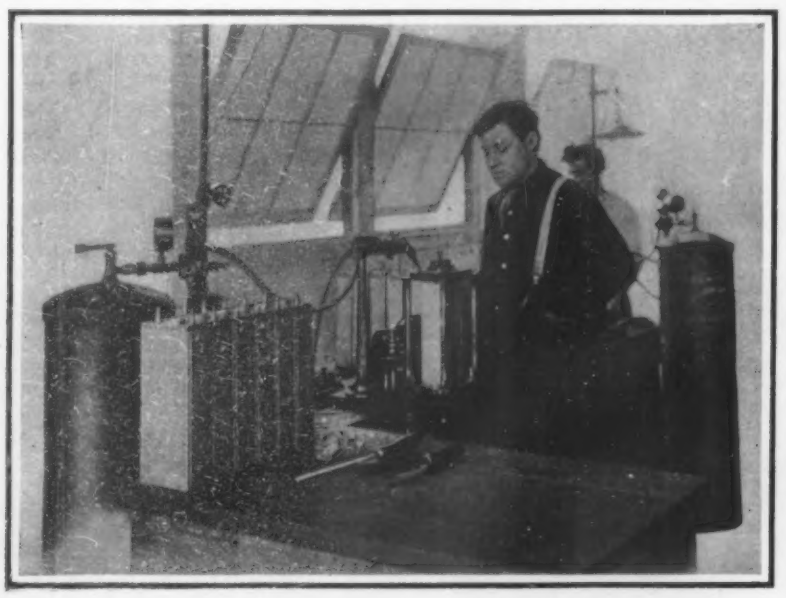
Positive plate at the right with nickel-hydrate active material in perforated tubes. Negative plate at the left with iron oxide active material in perforated flat pockets.



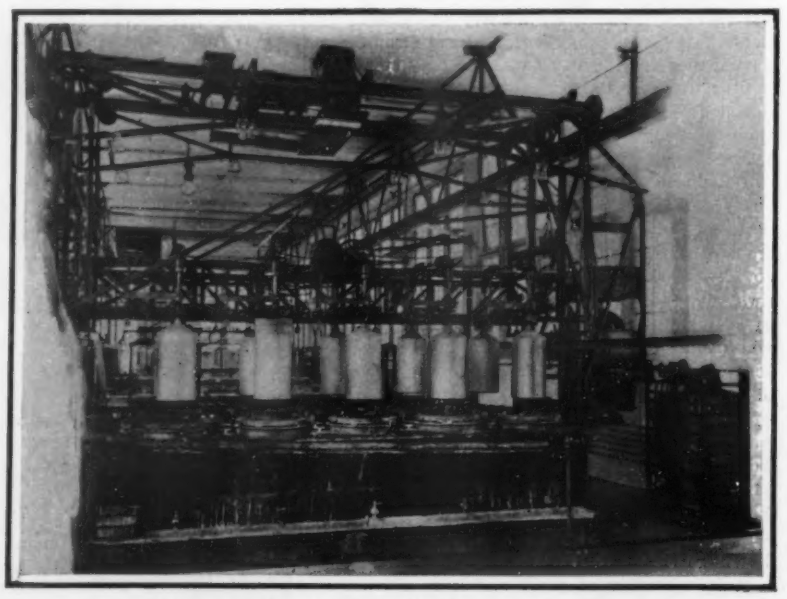
Element removed from can of Edison type A-4 cell. This cell is not in actual automobile use.



Complete 4-plate element of Edison electric vehicle cell removed from its containing can to show the structure.



Welding the steel cans for the cell.



Machine for electro-deposition of nickel for use in positive plates.

THOMAS A. EDISON'S LATEST INVENTION

The Modern Pleasure Electric Vehicle

Some Interesting Problems of Design and Construction and Their Solution

By William W. Hudson

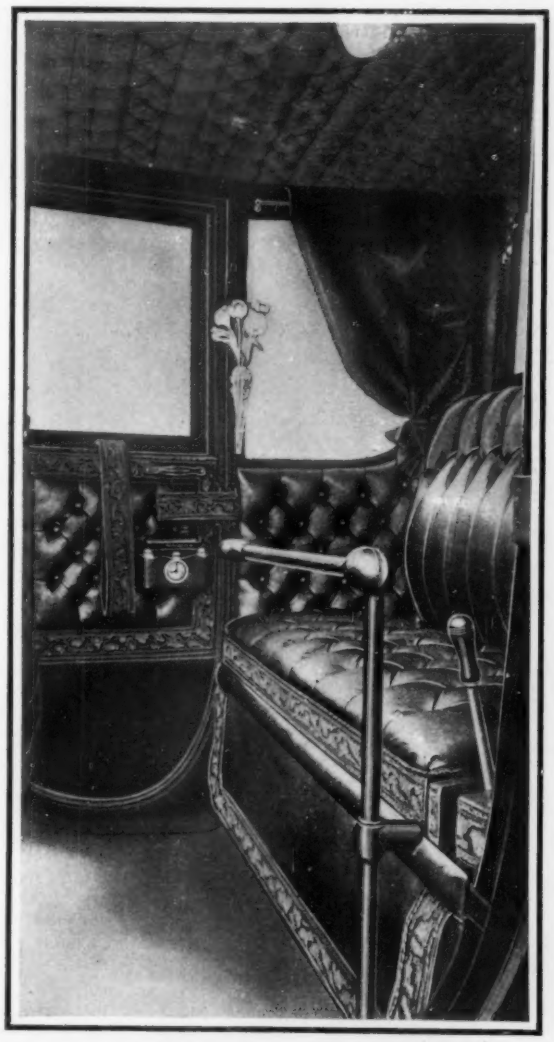
The electric pleasure car is coming into its own. For certain kinds of service it is ideal. Its simple and responsive control will always be its most remarkable feature. The gasoline car has perhaps obscured the development which the electric has been undergoing in recent years. Here will be found a summary of those mechanical and electrical perfections which have been introduced in recent cars, and which have elevated the pleasure vehicle to a remarkable pitch of perfection. Popular misconceptions are corrected, so far as the function and energy of the storage battery are concerned, and the remarkably luxurious furnishing of the electric carriage is illustrated. The manner in which the designer is handicapped in planning and installing a motor, the difficulty of obtaining a suitable drive, the many mechanical expedients devised to make the electric carriage a comfortable and easily operated vehicle, are set forth.

IF the problems of the electric automobile engineer might be summed up in a single word, that word would be *balance*. How to secure and how to maintain the nicest degree of balance between the elements he has to deal with, the limited power at his command, the unusual weights of his mechanism, the variable loads to be provided for, and the widely different requirements of future possible owners.

The popular misconception of a storage battery as a machine that stores the electric current with which it has been charged needs to be cleared up before the problem can be fully grasped. The storage battery is a chemical retort containing certain elements—lead, peroxide of lead, and sulphuric acid in the case of the lead pasted battery; iron, nickel, and an alkaline solution in the case of the Edison battery. The passage of an electric current through the cells (the process of charging) decomposes these elements, and the strong chemical affinity between the elements sets them at once to combining again. While this goes on electricity is given off (the process of discharging). The current thus given off during the chemical combination of certain elements is the whole power at the engineer's disposal. His problem then is above everything a problem in the economical use of power.

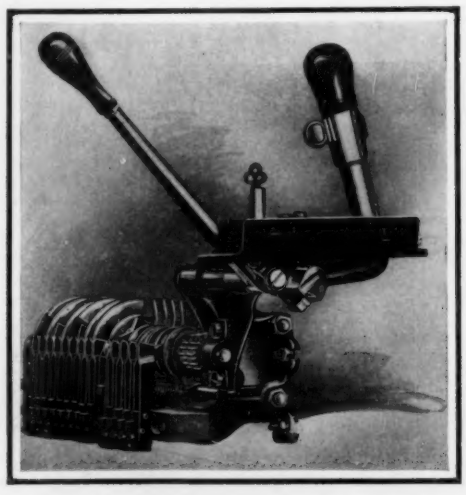
It is true that the energy in the battery may be increased by adding to the number of cells, and the mileage per charge extended by the use of thinner plates; but with the heavy or high mileage battery the ratio of torque to weight is very low, while with a battery of medium size the ratio is relatively higher, so that for the purposes of a pleasure carriage an economical limit is quickly reached, beyond which it is not wise or practical to increase the size of the battery. Electric carriages are in use with lead batteries ranging from 24 to 44 cells in size, but the number of cells is in general proportioned to the size of the carriage and the service required by the owner.

The most used and least expensive type of battery is the lead pasted battery, invented thirty years ago, but still in course of improvement and development. The composition of the plates has received constant study from chemical and electrical experts, and the materials now used differ in many respects from those of former years. This study of the conditions of battery service for electric vehicles has developed a plate of much greater efficiency than that of the older type. The use of wood separators has considerably reduced the weight of the batteries and added to their capacity. The adoption of thinner or higher capacity plates has prevailed within certain limits. The most efficient rate of discharge has been determined to a nicety and approximated in all recent construction. Finally, the elevation of the battery to admit of a greater accumulation of sediment below the plates has added largely to its life, capacity, and efficiency, and has materially reduced the cost of upkeep, both in lessening the necessity for frequent

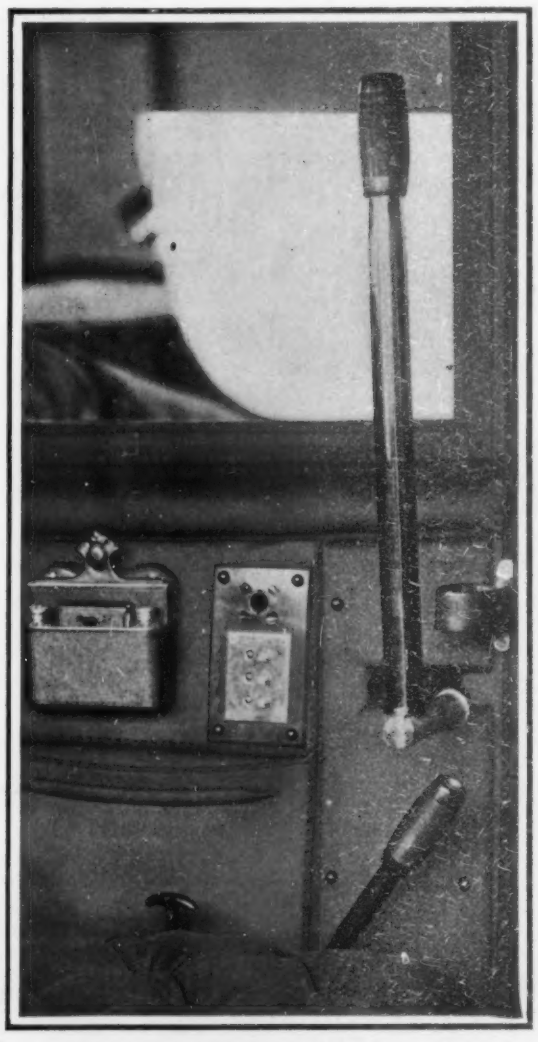


Interior of an electric brougham. A remarkable combination of upholstery and control devices.

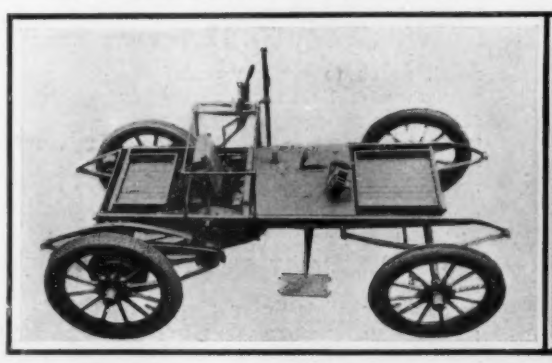
A typical controller for electric vehicles.



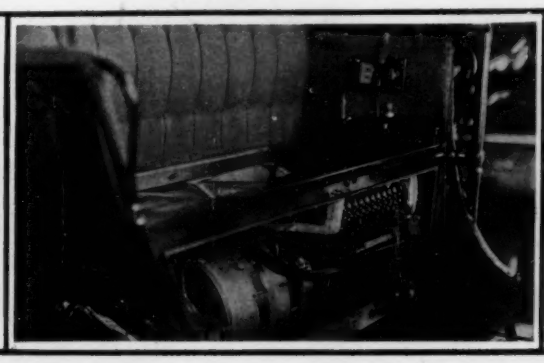
A knife-blade controller, one of the more highly developed forms.



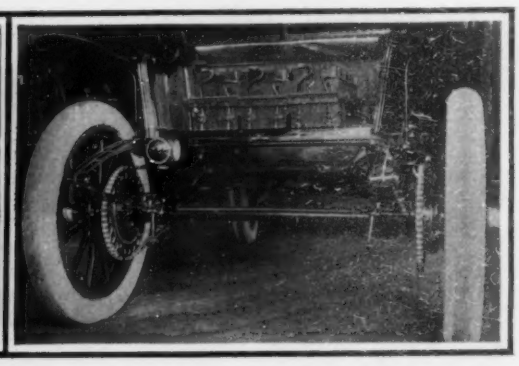
Steering-rod, switchboard, controller lever, and reverse lever of an electric carriage.



A chassis which shows a novel arrangement of motors worthy of attention.



Cylinder type of controller, showing location of motors under seat.



Rear axle, showing double chain drive, location of power plant, and one-half of battery cells.

THE MODERN PLEASURE ELECTRIC VEHICLE

washing and in extending the time before a renewal will be required.

In recent months the Edison nickel steel battery has come into practical use and has had its influence upon the design and construction of the latest models—an influence destined no doubt to increase with time. Of greater bulk and smaller weight than the lead battery, it has developed quite phenomenal mileage, and is believed to have considerably longer life than other batteries.

THE TYPE OF MOTOR.

The designer of an electric is limited again when it comes to the type of his motor. Economy of battery energy must be the first consideration, in order thus to increase the radius of travel and lengthen the life of the battery. It is a well-known fact that the life of any battery is in direct proportion to the number of discharges to which it will be subjected under fixed conditions. The essential factor in a motor built for an electric vehicle is great overload capacity. With a series-wound motor it is to be expected that the speed and efficiency will be at maximum with minimum load. The special problem in designing a motor is to preserve this efficiency as nearly as possible from minimum to maximum load. The four-pole series-wound Westinghouse motor is employed by some manufacturers; the compound-wound, multipolar Hertner type of motor by others. While there is a difference of opinion as to their relative merits, it is generally admitted that the compound motor draws a heavier discharge from the battery on grades, thus lessening the available mileage and increasing battery wear.

Having determined the type of his battery and motor, the designer will next consider the form of driving system that will present the highest ratio of torque to friction. The same problem has been met and wrestled with by designers of gasoline cars since the industry began, but with a difference. Economy of friction, which is a matter of some importance to the designer of a gasoline machine, is a question of the first importance to the designer of an electric automobile. Such matters as proper methods of weight suspension, proper distribution of weights, suitable gears and bearings, are of vastly greater significance when the available power is the electrical energy given out by the combination of chemical elements in a storage battery than they are when a gasoline explosion engine is producing the driving force. Among electrics, as among gas cars, there is a great variety of drives to choose from.

SELECTING THE DRIVE.

Several manufacturers still maintain their preference for roller chains, pointing out that this form of transmission is commonly used in racing cars of the gasoline type, owing to its high relative efficiency. The objections most commonly raised to chain drives are their noisy running, their rapid wear, their exposure to dirt and dust, and consequent loss of efficiency after wear. To avoid these troubles the tendency of the most advanced motor-car construction has been toward the adoption of some form of shaft drive. Among the limitations of the electric designer is to be noted the fact that some forms of shaft drives that have been successfully adopted by gasoline builders have not met the requirements of electric service.

Several successful forms of shaft drives are, however, now in use. The earliest designs of these used a metal spur gear for the first reduction from motor to countershaft; but as this caused noise and friction, resort was had to a gear of compressed rawhide. This was a slight improvement, but still with obvious defects. Worm gears were next tried, but finally the Renault silent chain was introduced, and this has been adopted for the first reduction by most builders of high-grade electrics. One manufacturer, however, has just announced a driving system in which the power is transmitted to the shaft through a universal joint that forms part of the rear motor head, thus eliminating the first reduction. Particulars of this device and of its operation will be awaited with interest.

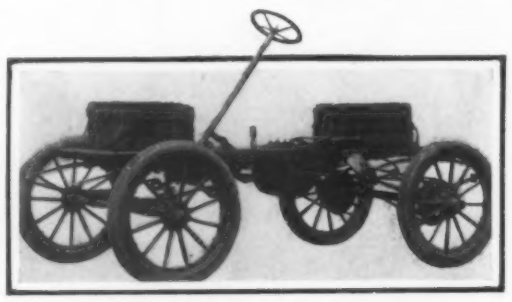
The second reduction from the driving shaft to the rear axle is by some designers effected through bevel gears. The success of this method depends partly upon the design of the gear teeth, partly upon the process of hardening the steel, and partly upon proper provision being made for the self-alignment of the gears. In any case the gears must be completely housed and should run in a continuous bath of oil.

The accompanying drawing of an electric driving system shows a double reduction drive in which the power is transmitted first by a flexible gear to a universal shaft parallel to the rear axle and then through herringbone gears to the axle. It is well known that gears connecting parallel shafts give the highest percentage of efficiency, while the efficiency of herringbone gears has been fully established at above 98.5 per cent. (See SCIENTIFIC AMERICAN for February 12th, 1910.)

The driving axle is of the full floating type, the axle tubes being made by swedging and upsetting the tubing in dies so as to give an extra thick wall at the point where the diameter of the tube is reduced for the wheel bearings, this method being adopted to make a one-piece tube with no brazing. The driving shaft

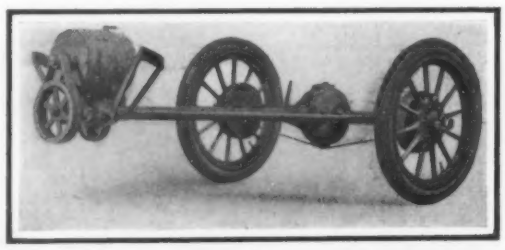
A neat electric phaeton.

may be removed by taking off the dust cap and pulling it endwise. This allows the differential case, driving gears and pinion to be removed from the axle frame, which permits the inspection of every part, all being put together again with very little work. The flexible gear runs on a sprocket cut like a gear wheel, is inclosed in a dust-proof case and runs in a con-



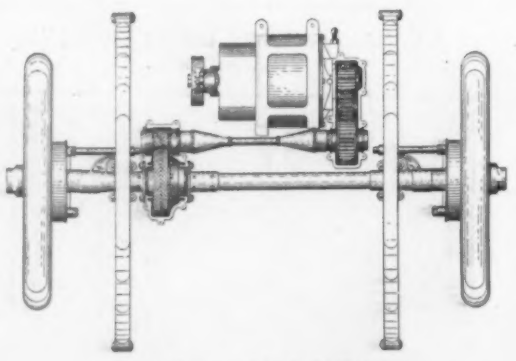
Chassis of an electric carriage.

tinuous bath of oil. The motor and flexible gear case are combined in a single unit and assembled on cross pieces attached to the body frame. Rubber cushions are used to overcome the effects of vibration. The whole unit may be disconnected from the car in a few minutes' time by removing the locking screw in the universal joint, thus permitting the sleeve to be



The power plant of an electric car. The chain in front is covered with a dust-proof aluminium case.

slipped from the joint and the universal shaft to be taken out. The motor can then be dropped by removing the two supporting rods that connect the field frame to the motor support. The simplicity of this device for removing, inspecting and reattaching the driving system is a matter of universal interest to garage men.



Gears of a non-bevel shaft drive.

Of equal importance with the problems just described are those connected with the design of an electric vehicle controller. Many of the early failures of the first designers of electrics were owing to troubles with the controller. Arcing controllers were a constant source of mischief and perplexity to these early builders and of prejudice against the vehicle on the part of the owners.

THE CONTROLLER.

The form of controller used in most up-to-date electrical construction is of the knife-blade contact type. The particular instance where this controller is used on an electric vehicle shows a core on which are assembled blades of various widths and locations that engage on fingers consisting of two pieces which are assembled on the controller frame. These make the knife-blade contact of liberal area with different speed notches. The blades are made of brass and the fingers of phosphor bronze. The speed controller consists of four notches, the first two being resistance notches with the motor field in series, the third and fourth with series at all times. There are four reverse speeds similar to the four forward speeds. The method of connection is such that the circuit is never broken after the power is once applied, giving a continuous torque to the motor and preventing any jerking or arcing between the speed notches.

An emergency key is fitted in the top of the reverse lever and serves to mechanically unlock the position of the reverse lever switch. This reverse switch has three positions—forward, neutral, and backward. In the neutral position a tongue engages automatically the fixed part of the controller frame. The key serves the purpose of disengaging this tongue, which allows the reverse switching to make the electrical connections for either forward or backward motion, and does away with a plug switch.

The continuous torque drum type of controller is preferred by some engineers, and the vertical radial type by others. The essential feature of all, however, is the provision of liberal contact areas that will prevent arcing in changing speeds, and this has been accomplished in all modern types of electrics.

Another problem of special interest to the designer is the steering system. A few manufacturers use the wheel steer on particular models, and owners of gasoline cars often express a preference for this form of steering system in purchasing electrics. Combined with a practical foot control in the hands of a skillful driver, the wheel steer has undoubted advantages in operation; but in ordinary use the foot control may prove a positive danger to the occupants of the car, and for that reason it has been abandoned by most designers. With the controller handle set, for instance, on third speed, if the resistance, or foot control, is suddenly applied, the car may be brought to a full stop. Then, when the foot is lifted, unless special care is taken to let the foot controller back to neutral position gradually, there will come a sudden jump into high speed that is certain to be unpleasant and may be dangerous. For this reason most designers have abandoned the foot control as unsuitable for a carriage that may be frequently driven by women or children. Having to keep one hand constantly on the controller lever, the driver soon discovers that the wheel steer is less convenient than the side lever steer, and for this reason the latter has been most generally adopted.

The effort to reduce weights to the minimum has led many gas car designers to adopt semi-elliptical springs. The practice has also been followed by some designers of electrics; but with the shorter wheel-base and the heavier weights of the electric mechanism, the slight reduction in weights gained by the use of semi-elliptics is obtained at so great a cost in discomfort to the passenger and wear and tear on tires, battery jars and the finer parts of the machine, that the most approved of the later designs include the use of full elliptical springs with supplementary cross-springs front and rear.

Other problems having special interest for the designer are braking systems, types of axles, hubs and bearings. Add to these the important questions connected with body design, finish and furnishing, and it will be seen that the designer of an electric automobile has plenty to occupy his time and his gray matter.

Many unsuccessful experiments, states the Metal Industry, have been made in the hope of utilizing magnesium, as owing to its extreme lightness it would be most suitable, if it could be alloyed with another metal, so as to produce an alloy which combines strength with lightness, as there is a considerable field for one not only in the construction of aeroplanes, but for many other branches of engineering where weight is a consideration. Magnesium has a specific gravity of 1.7, so that it is much lighter even than aluminium, whose specific gravity is 2.6, while that of iron is 7.8, so that magnesium is more than five times as light as iron and 50 per cent lighter than aluminium. A recent French patent describes a process of manufacturing alloys of magnesium and zinc, containing as much as from 90 to 96 per cent magnesium. The same inventor claims to have succeeded in making a practicable alloy of calcium, whose specific gravity is 1.58, and which is therefore even lighter than magnesium, with zinc, copper, or aluminium, or a mixture of these three metals.

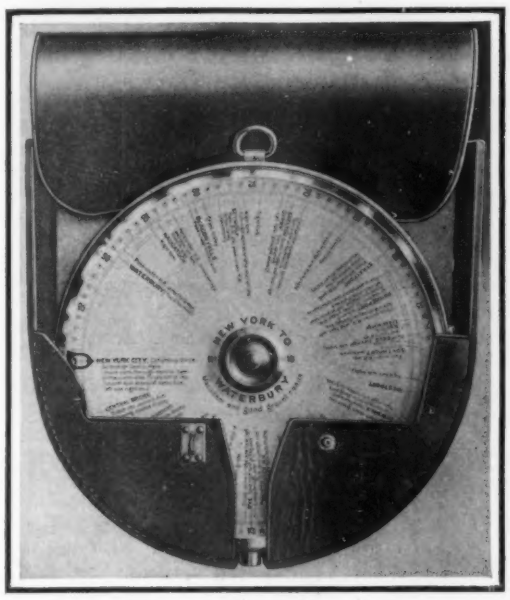
Some Remarkable Mechanical Road Guides

Ingenious Devices which have been Invented to Supplant the Guide Book and Chart

By Harry W. Perry

The difficulty of handling maps and guide books in a car traveling at considerable speed has led to the invention of many ingenious substitutes. All of them are intended to reveal the proper route. Some of them do this mechanically; some of them by manual operation. There is not one of them but presents some interesting mechanical feature which should interest not merely the automobile user, but any man interested in new inventions. Incidental to the purchase and use of certain of the instruments is an elaborate system of co-operation with the best hotels in all the important cities and resorts on the various routes whereby additional route cards or strips can be bought in the lobby and slightly reduced rates obtained on accommodations.

ALL tourists by automobile know the difficulties and annoyances of finding and keeping on the best routes to their objective points. They early learned not to place any dependence upon local residents for simple and reliable directions. Only within the last



A disk that guides you from New York to Waterbury.

two or three years has the work of sign-posting through roads been prosecuted vigorously and extensively, the States, counties and townships preferring to leave this public work to be done by automobile clubs and good roads associations. Chief reliance for sure guidance has been placed upon folded road maps, route cards and route books. These contain much essential information, especially the automobile route books, but they also have certain objectionable features. They flutter and become torn in the wind, rain wets and spoils them; the bouncing and swaying of the car make it difficult to follow the directions or keep the place, and after dark they are hard to read and almost useless unless the car is fitted with a good swivel searchlight that can be thrown on such sign-posts and landmarks along the way as are referred to in the book or indicated on the map.

It has been the object of a number of inventors of late to overcome these difficulties and simplify the unwelcome task of finding the route by producing mechanical devices for attachment to the car that would serve to guide the motorist unerringly over any chosen route he may elect to follow. Three such instruments have been perfected and put in the market. Patents have been issued on others, and more inventors are still at work along different lines.

A LIVING CHART.

Of those already available for general use, the distinction of being first in the field appears to belong to the "Live Map," as its inventor has very aptly named it. This is a very simple instrument, consisting of a flat, circular, polished metal case about 8½ inches in diameter having a hinged glass face and containing a train of gear wheels connected to a revoluble metal center piece and to a flexible shaft. The flexible shaft terminates in a spur pinion carried in an adjustable bracket to be attached to the steering arm of the car, so that the pinion will mesh with and be driven by a large spur ring secured to the inside of the road wheel. The revoluble center disk in the case is provided with three steel studs so that a perforated paper disk can be slipped over them and made to revolve with the center piece. At the left side of the case is fixed an immovable steel pointer, blued to contrast with the white disk.

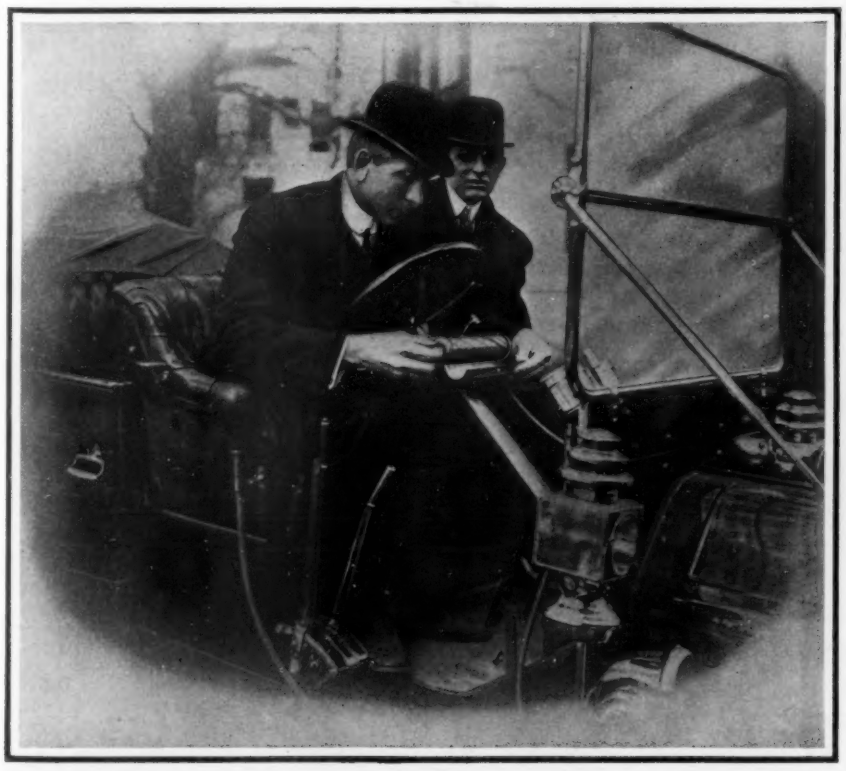
The face of the circular card is printed with a scale of miles around its perimeter reading from 0 to 100, each mile indicated by a number and every fifth mile printed in heavy type. Intermediate fifths of a mile are indicated by short lines. All necessary road directions are printed in plain type on the face of the card radial to the center, with a line drawn from each to a point on the scale corresponding to the exact distance from the starting point in miles and fifths of a mile, to which the printed direction applies. The directions are simple and concise, yet are plentiful and ample, showing exactly when and which way to turn, naming the streets to take when passing through cities and towns, indicating when to cross railroad tracks, bridges and trolleys, when to keep straight ahead, and which fork to take when the road divides. Landmarks are mentioned incidentally at frequent intervals to reassure the tourist that he is still on the right road.

Assuming that the motorist starts at the exact place where the route card begins, the card is placed in the instrument with 0 immediately under the pointer. Should he start at some intermediate point, however, the card is set with that point under

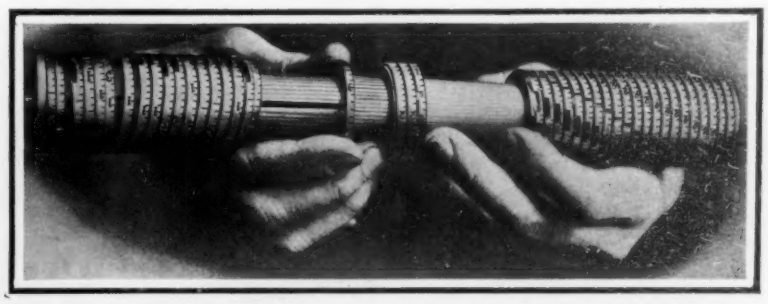
This road guide is fitted to the steering column and is operated by hand.

the pointer, a thumb screw on the back of the instrument permitting the center piece and card to be moved at will without interfering with the driving gears. As the car travels, the dial revolves very slowly, making only one complete revolution in 100 miles; and as each separate road direction comes directly opposite the pointer, it tells the driver just how to proceed. The mechanism is made with the utmost accuracy, so that the scale on the dial will correspond exactly with the distance traveled and the pointer always show the motorist just where he is—a fact that is one of the most important features of the device, as one of the great difficulties with

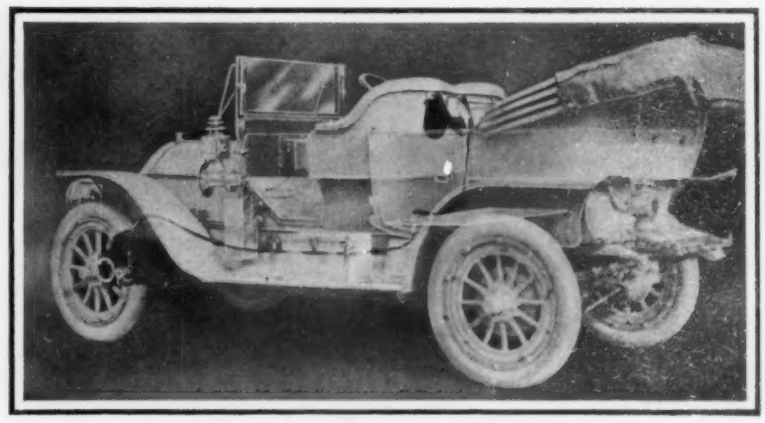
(*Continued on page 47.*)



Opening pathfinder before resetting the device for a new route to be traversed.



A hand-adjusted guide. Method of resetting direction and mileage rings.



How the live map is attached and operated.

SOME MECHANICAL ROAD GUIDES

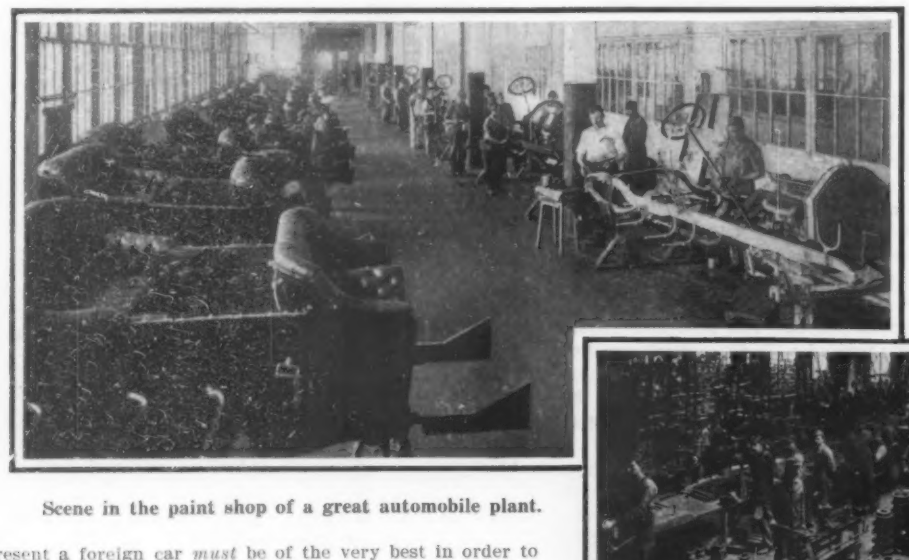
Why You Can Buy a Good Car for Little Money

The Mass Production of Motor Cars

By Harold Whiting Slauson

It is now possible to buy a car for less than two thousand dollars which is better than the car for which five to seven thousand dollars was paid ten years ago. To bring this about, new tools had to be invented, new shop methods devised. The following article discloses the system which has made possible the modern cheap and efficient automobile. The result of the almost universal use of machine tools in the manufacture of automobiles in this country has been not only to increase the output greatly and the interchangeability of parts, but it has had the effect as well of standardizing the product of the makers as a class.

A FEW years ago a comparison of the representative merits of American and foreign cars offered no opportunity for discussion, for the latter were admittedly the superior in every way to our own products in the line. To-day, however, while it can hardly be said that these conditions are reversed, we find the American cars at least holding their own with their foreign competitors, and in many cases demonstrating actual superiority; and so at the present a foreign car *must* be of the very best in order to find a profitable market in this country.



Scene in the paint shop of a great automobile plant.

The figures show that, not only are we making automobiles to supply practically all the users of our own country, but that we are shipping them to foreign countries to the extent of from fifteen to twenty-two million dollars worth a year. To be sure, our sister republics in this hemisphere provide a large market for this export trade, but the medium-priced American car is finding its way even into the very heart of the countries whence came its former competitors.

This home and foreign consumption has increased in face of the fact that we pay our skilled labor several times what the artisans of Europe receive, and that some of our best materials are still imported and are subject to a high duty. The rise of the American car in the face of these handicaps until it is now a competitor of the product of the cheaper labor of Europe is due entirely to the improvement in the shop and factory methods and to the efficient organization that the last decade has brought about.

The European cars are nearly all built by skilled labor, and one might almost say that the quality of the product depends upon the personality that each mechanic puts into his work. Infinite care and detail are bestowed upon each part. As the work is all done by hand by the individual workmen, it is small wonder that, even with the prevailing low wages, the well-built foreign car is expensive at best. These same methods formerly obtained in the construction of the American car, and as the wages received by the workmen here are higher, it can be seen easily how the foreign-built automobile secured a firm foothold in this country.

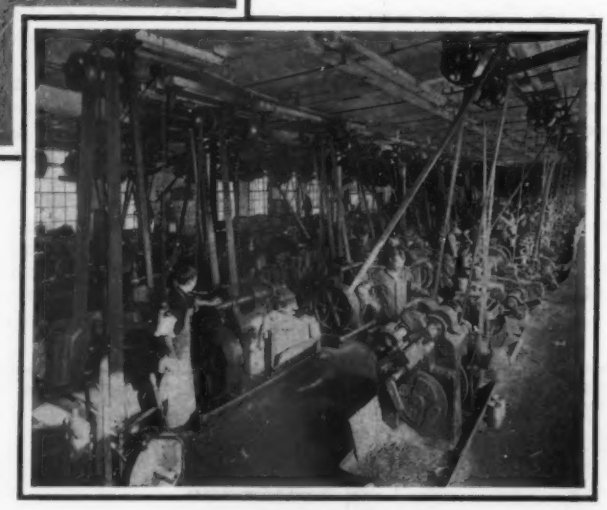
Automobile parts by the thousand.

To-day, however, the methods are so changed that the first thousand automobiles made in this country would scarcely recognize the place and manner of their birth. Instead of being *built*, one at a time, with infinite trouble and pains, they would find themselves *manufactured* in a single day, in company with thirty or forty others—turned out of automatic machines, as it were; and yet the quality and serviceability of these latter-day motor cars are far superior to those of their earlier predecessors. It is the same change in method that stimulated the watch industry. To-day, in the modern automobile factory, we see the cold-chisel and the hammer replaced by the power cutter and planer, the emery grinder doing the work of the file, and a multiple or gang drill performing operations that formerly required the use of a dozen separate drill presses.

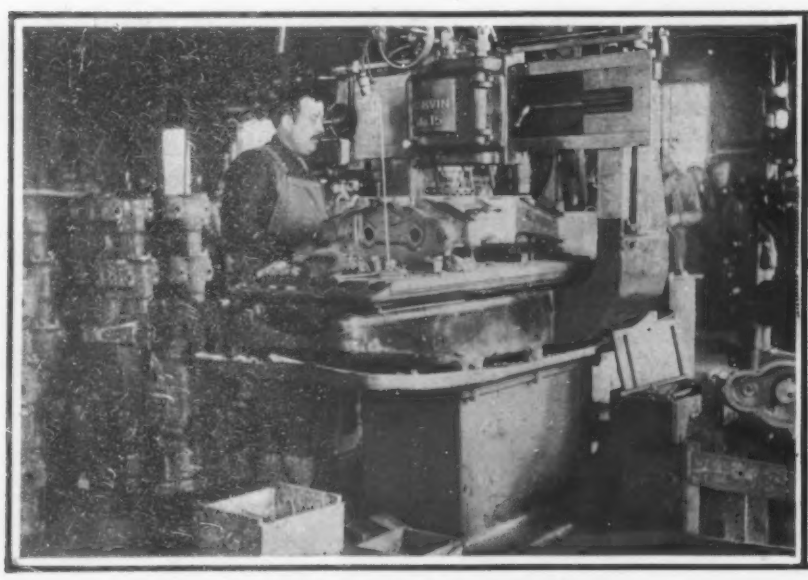
Gear-cutting machinery has been well nigh perfected for a number of years, and it was a comparatively easy matter to install in the progressive automobile factory such devices for the rapid production of all spur and bevel gears for the transmission, motor, and differential as were already in use in other modern shops. In consequence of this, it is probable that the most radical changes have been made in the design of the machines used for boring and grinding the cylinders and for facing off the crank cases and lining up their bearing centers.

CYLINDER BORING.

Boring the walls of a rough cylinder casting is but a slow operation at its best, particularly if several cuts are to be taken, and inasmuch as it is not advisable to increase the speed of the tool beyond a certain extent, time can be saved only by working on several castings at once. This is well accomplished in some factories by the use of a battery of double boring mills, several of which can be attended to by one man. Such a mill may consist of two spindles, parallel to each other, in each of which a boring or cutting tool is placed. These spindles are both driven by the same belt from the overhead shafting, and each bores one of two cylinders placed side by side in a fixture on a turret. Such cylinders



Piston-ring and other lathes.



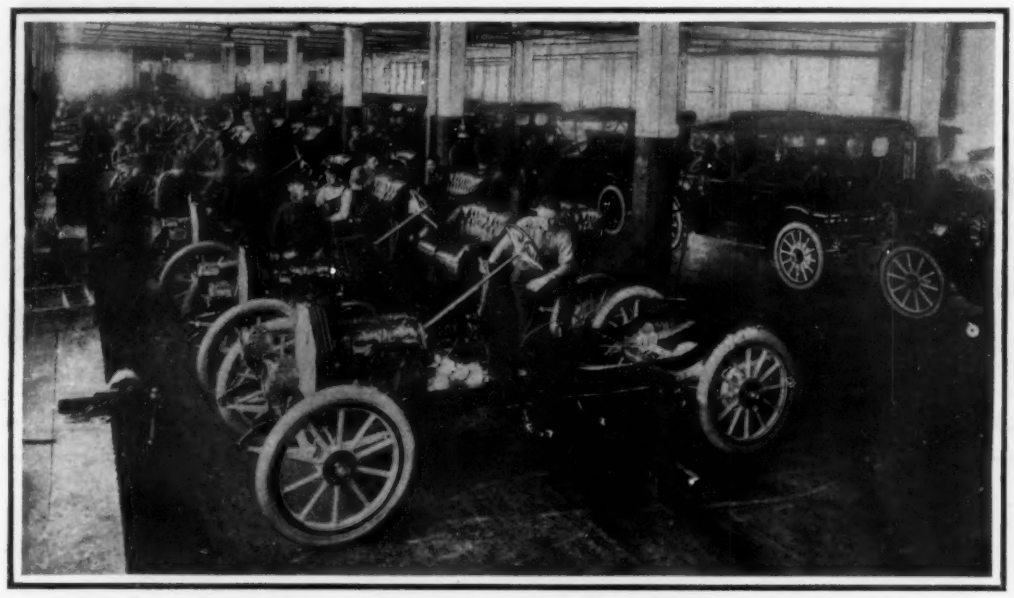
"Cathead" at work on a motor crank case.

Testing motors by the dozen.

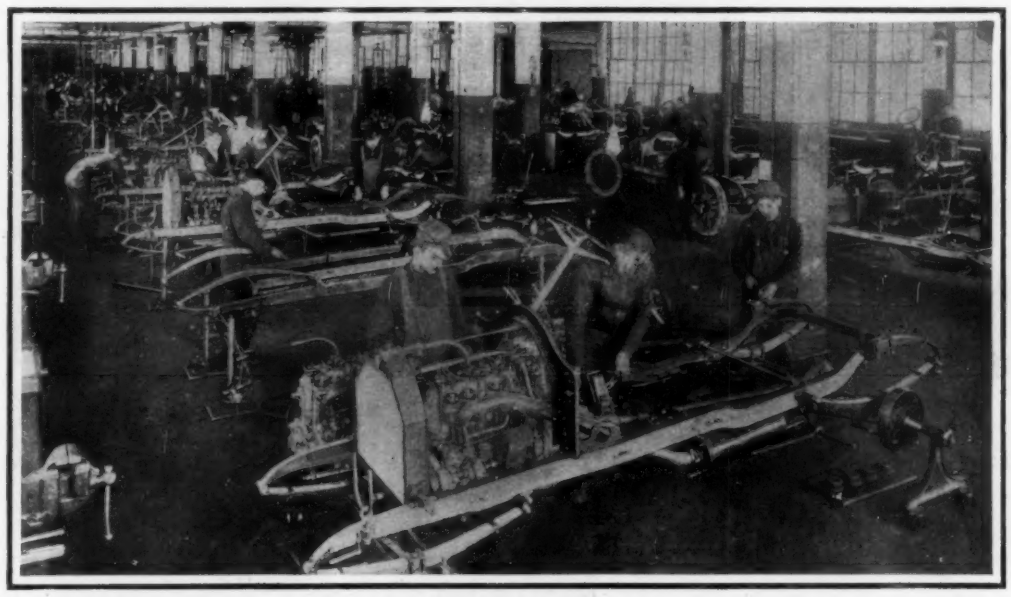
may be cast in pairs, or separately, but in either case both can be bored at the same time, and as the speed of the two spindles and the adjustment of the two tools are the same, the pieces will be finished together and the results will be identical.

While this boring operation is going on, another pair of cylinders may be fastened in the proper position to the back of the turret, ready to be swung into place as soon as the first pair is finished. The fixtures on both sides of the turret are so designed that the cylinders may be placed in exactly the proper position with very little trouble on the part of the operator, and he is thus enabled to take care of a battery of several of these mills. Automatic stops are provided on each mill so that the feed of the spindle will cease as soon as the end of the cut has been reached. The great saving in time accomplished by such a system lies in the fact that the spindles need never be idle except for the instant required to swing the turret and bring the new work into position, for the completed cylinders are removed and the third set secured in place while the boring is in progress on the second pair. The cylinders used in the high-powered cars are very heavy and unwieldy, particularly if they are cast in pairs, and in order to facilitate the handling of such parts, some of the large factories are equipped with compressed air lifts by means of which the work may be raised from the floor and carried to the various machines.

Nearly all cylinders for automobiles are now ground before installation in the completed motor, an operation that doubtless adds much to the efficiency of the modern car. Although grinding merely removes the tool marks left from the boring mill and makes an absolutely smooth and nearly glazed surface on the interior of the cylinder, it would be a long and expensive process, were it not for the almost general use of a special grinding machine. This machine consists of a horizontal spindle set in an adjustable eccentric bearing with an automatic, longitudinal feed at its end. An emery wheel is secured to the end of the spindle, and as this shaft is revolved rapidly on its own axis, its eccentric bearing is turned more slowly in the opposite direction, giving a circular sweep to the emery wheel. The bearing is so set that the sweep corresponds in diameter with the bore of the cylinder to be ground, and as the operation progresses, the emery wheel is fed into the casting. It is seldom that more than a few thousandths of an inch are desired to be ground off from the walls of the cylinder, and consequently two or three repetitions of this operation are generally sufficient and a battery of these machines can easily take care of the product from several times their number of boring mills. Most of these grinders are equipped with suction air pipes that serve to remove the emery and iron dust as it is produced in the cylinder.



The assembly floor of a great automobile factory.



Putting chassis together.

WHY YOU CAN BUY A GOOD CAR FOR LITTLE MONEY

THE WONDERFUL "CATHEAD."

The crank-cases of the majority of automobile motors of to-day are of aluminium, and as this is a metal that can be worked at a comparatively high speed, the many machine operations required by the crank-cases are performed easily and quickly. As the crank-case is also the base of the motor on which the cylinders are secured, its upper surface must be very smooth in order to help form an oil-tight joint. Hence practically the entire upper surface, as well as parts of each end, must be faced off, an operation which, if performed in the ordinary planer or shaper, would be exceedingly slow. By means of a vertical mill and a disk to which are attached several cutting tools, the facing off of the entire surface may be done with great dispatch. This tool is known as a "cathead," and as it revolves in a horizontal plane the bed to which the crank-case is attached is fed under it, thus facing off a surface with each cut that is as wide as the diameter of the disk, or cathead. The ends of the crank-case may be faced off in the same manner, and if it is desired to cut a flange for the forward train of gears, the separate tools of the cathead may be adjusted accordingly.

The multiplicity of operations that may be performed on a single piece by means of modern shop machinery is best exemplified by the treatment of the bearings for the different shafts that are located in the crank-case. Many motors are designed with two cam shafts, and these, with a three or five-bearing crank shaft, may make necessary as many as fifteen bearings in a single crank-case. Many of these are of different sizes, and yet machines are in use which will cut or bore all of these at once. In addition to this, some of these machines are equipped with a vertical spindle and cathead that will face off the upper side of the crank-case at the same time. As the various bearings of the crank-case will be located on three parallel lines corresponding to the positions that the crank shaft and cam shafts will occupy when assembled, only three spindles are necessary for this bearing-cutting machine. Each spindle is provided throughout its length with slots in which adjustable cutting tools may be placed, and by setting these at the required length, the proper cut for each bearing will be made when the spindles are removed and the bed to which the crank-case is secured is moved to form the feed.

HOW THE GANG DRILL HELPS.

One of the most useful tools brought to the aid of the automobile manufacturer, and one that enables him to turn out a great amount of high-class work in a short time, is the multiple, or gang drill. The individual spindles of such a machine are connected to the power shaft by a pair of universal joints, and by means of these any drill may be moved any place within a limited radius. When moved to the proper position the drill may be set and locked, and by obtaining the right combination of positions of the different drills, a set of several holes may be drilled in a surface at the same time. Absolute accuracy so far as the proper location of these holes is concerned is obtained by means of a jig. By the use of one such machine, properly set, one automobile factory is enabled to drill all four holes in the bearing caps of two connecting rods at the same time with scarcely any more trouble than would be required to bore a single hole. The same type of machine, when set for different work, can drill all the holes of different sizes necessary in the upper surface of the crank-case; and here, too, the use of a jig makes the nearly automatic results far more accurate than could ever be obtained by trusting to a workman's eye and hand.

The advantage of the gang drill is particularly noticeable when used on a motor cast *en bloc;* that is, with all four cylinders cast in one piece. In one factory in which such motors are made, a double multiple drill is used with the spindles so set that every hole required in each cylinder may be drilled in two castings at once. This really means, then, that eight cylinders can receive their full quota of drilled holes simultaneously.

But all this labor-saving machinery will be of little avail unless the various tools are so arranged that a minimum amount of handling will be required for the work. With this arrangement in view, the machine tools are placed in a relation corresponding to the progress of the work on each part, so that, as each piece is finished in one machine, it may be carried to the next adjacent machine for the succeeding operation. For example, near the boring mills will be found the drill presses for the cylinders, while beyond these will probably be placed in order the valve-pocket reamers, the shapers for facing off the bottom of the casting, and the grinding machines. The crank-cases follow the same general plan, and are so routed that each piece need only be lifted from the planer to the reamer or the duplex boring mill, and from this to the gang drills.

This is all, of course, a matter of highly-specialized workmanship, and each man will attend only to his own machine or battery. On this account, some pieces may pass through the hands of at least a dozen men, and when the amount of work required on each of the thousand and one separate parts of a motor car is considered, it will be realized that a great number of skilled artisans of various classes are required for the manufacture of a modern automobile.

GRINDING FOUR VALVES AT ONCE.

The extent to which quantity production has found its way into even the smallest operation of the construction of a motor is well exemplified in the factory of one of the leading automobile companies of the country. The valves of every motor must be ground before it is ready to run, and while this is not a difficult or long task, the factory has improvised a machine that will grind four valves of a motor at the same time and with no more attention from the operator than though he were confining himself to one valve. This valve grinder is in reality a converted quadruple drill press, having the spindles driven by bevel gears connected to a common power shaft. The spindles are set at the proper distances apart to correspond to the valves in the pair of double-cast cylinders, and by a simple tripping device the pressure on the valves is released at frequent intervals to allow new grinding material to

(*Continued on page 49.*)

The Commercial Motor Truck vs. the Horse

A Comparison of Efficiencies and Costs

By Harry W. Perry

If the celerity of movement, the power, and the beauty of line and finish of the pleasure automobile quicken the pulse with admiration, what is the mental impression created by the majestic movement of a massive motor truck carrying a five-ton load of merchandise swiftly through the city streets or the suburban road? The independent and certain coming and going of motor wagons and trucks day in and day out in our large cities, engaged in a great variety of work, is one of the most impressive and significant features of present-day industrial and commercial life.

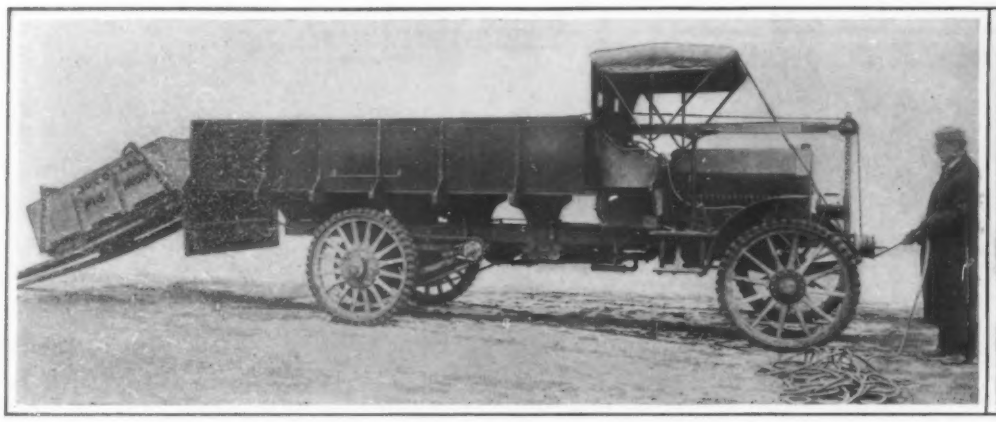
IN the light of what has been accomplished by mechanics in street railway service, in railroading, in shipping, and more recently in pleasure driving on the public highway, it seems absurd ever to have doubted that ultimately the mechanical transport of materials and merchandise of all sorts would supersede their movement in the old, slow and inadequate way by horseflesh. It is visionary to assert that the horse ever will be wholly displaced, either for pleasure driving or for draft purposes, but it is not too much to say that the time is not far off when no up-to-date business, dependent upon a delivery or drayage service, can afford to employ horses in or near a large city. Without doubt this will come as an unbelievable statement to a great many persons who never have studied the subject or had opportunity to observe what is being done with motor trucks and delivery wagons in New York, Chicago, and other cities, and in many rural communities, even in remote mining districts.

The assertion does not necessarily mean that in all cases a store or other business can maintain a motor delivery or transfer service at less cost than an equivalent horse service, but it does imply that such a business will lose trade to competitors who, by the use of motor transportation, will be able to make deliveries in less time and at greater distances, or will be able to transact a greater volume of business in a given time. Federal authorities and municipal bodies throughout the length and breadth of the land have long recognized the tremendous advantages possessed by the motor vehicle in the matter of speed and of ability to give continuous service without fatigue. That is why we hear of the introduction of motor wagons in the postal service in many places, as in New York, Indianapolis, Detroit, Washington, Milwaukee, and other cities and the proposal to place them on rural free delivery routes, and the adoption of self-propelled fire apparatus, police patrol wagons, and ambulances in large and small cities.

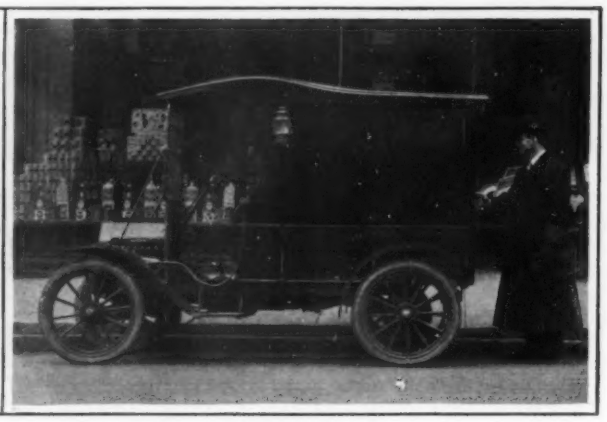
Merchants and manufacturers may feel under a greater necessity than federal and municipal bodies to utilize the least expensive in preference to the most efficient transportation system and hence have been very conservative in regard to the adoption of commercial motor vehicles. But many of the most progressive private and quasi-public companies in the country have adopted motor wagons and are using them with great success. Some have depended upon them for years, and a few have abandoned horses altogether. As a single instance, the second largest department store in New York city depends absolutely upon gasoline trucks and electric trucks and delivery wagons for its entire transfer and delivery service, which extends to points thirty miles from the store, to which deliveries are made within twenty-four hours after purchases are made. With the many installations that have been in successful operation in wholesale and retail trade for varying periods dating back, some of them, five to ten or more years ago, sufficient data are available to any earnest inquirer to convince the reasonable mind of the all-round serviceability of the industrial motor vehicle.

So much attention has been directed to the relative cost of motor service and horse service that in the minds of many this is the chief if not the sole deciding factor between the two. In some trades it may be quite right to make it so, but in most lines of business quickness of service, range of operation, dependability, and other factors are, perhaps, of really greater importance. A mill or factory, for instance, that installs the most up-to-date machinery and rapid production methods, transacts its sales by telegraph, and makes shipments by express is not following a very consistent policy if it hauls its shipments to the express offices in slow-moving drays when motor trucks would take them there in one-third or one-quarter the time. Even if the latter service were more expensive it would be justified, but there is ample proof that to-day the cost is actually less than that by the old system.

The mercantile world is really waking up to the transportation situation and a great deal more interest has been taken in motor business wagons during the past year than ever before. This is due, of course, in a large measure, to the activities of the manufacturers of such vehicles, of whom there are now known to be more than 100 actually producing machines of different types, and also to the very significant fact that the mercantile houses and other concerns that have adopted mechanical road transportation have adhered to it and have from year to year supplemented their original purchases by reorders for the same or other makes of motor vehicles. The cases in which



Unloading 3,000 pounds of pig iron from a heavy truck.



A light delivery vehicle.

The modern way of haying. Compare the size of the truck with the size of the horse-drawn wagon.

THREE EXAMPLES OF THE KIND OF WORK WHICH THE AUTOMOBILE TRUCK DOES

business houses have adopted motor wagons and, after a fair trial, have abandoned them to return to horse service, have been very few.

It is highly indicative of present interest in this subject that for the first time in six or seven years commercial vehicle contests have been held during the past year, four such events having been conducted with considerable success in Philadelphia, Boston, New York, and Chicago. The object in all cases was to demonstrate the reliability and operating economy of motor truck and delivery wagons, both gasoline and electric. The Philadelphia contest was held August 12th and 13th and 69 vehicles participated, running to Atlantic City the first day and returning to Camden, across the river from Philadelphia, the second day. The vehicles ranged in capacity from 600 pounds to 7 tons, and were loaded to full rated capacity. The running schedule of the largest truck was 8 miles an hour, of the intermediate sizes 10 miles, and of the light delivery wagons 12 miles. All but eight of the machines that started finished the round trip, and of the nine electric vehicles that started none failed to cover the whole route. The largest representation of any one make was twenty Autocars, of which all but one finished. A Packer's 3-ton truck, loaded, made the trip one way in 1 hour, 32 minutes, exceeding the schedule for its class by 1 hour 40 minutes and also that of the fastest class. Two Frayer-

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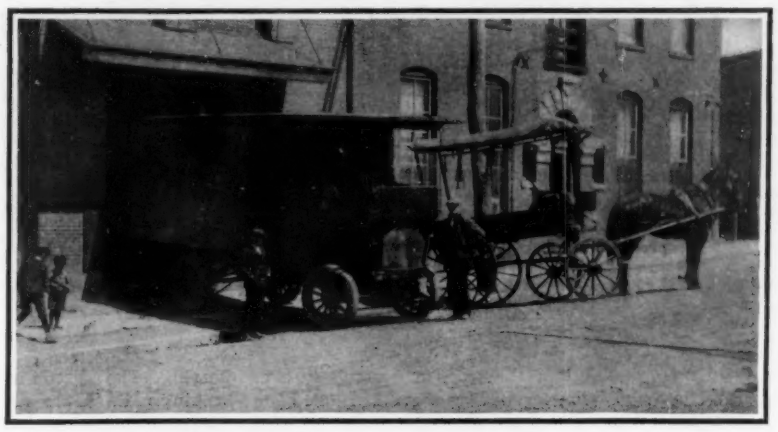
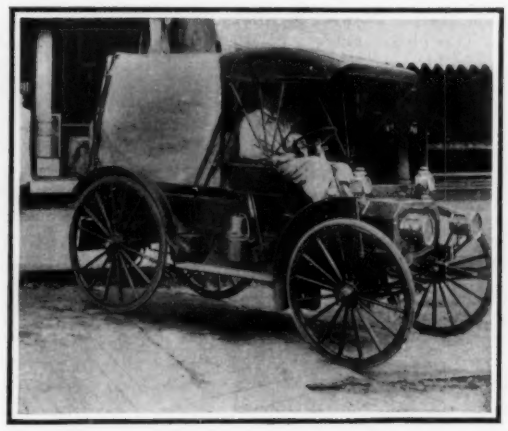
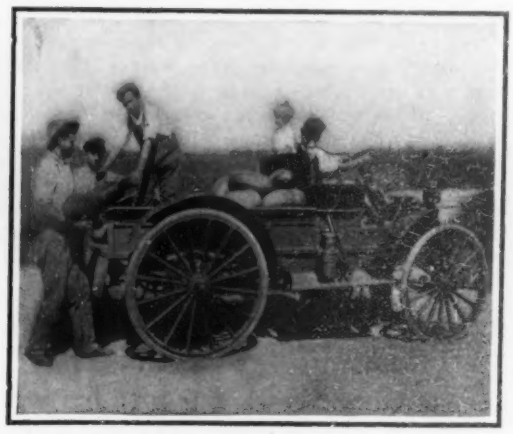


The old and new way of delivering goods.

A brewer's truck that has been running for nine years.



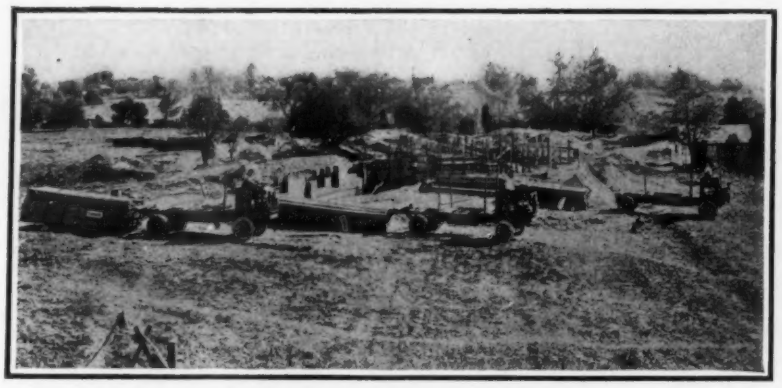
A high-wheeled gasoline delivery wagon.



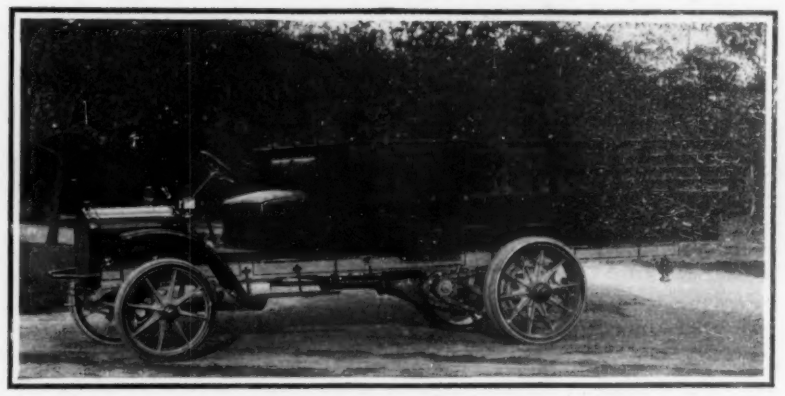
The modern farm wagon.

Two German automobile trucks for farm use.

An automobile sight-seeing car.

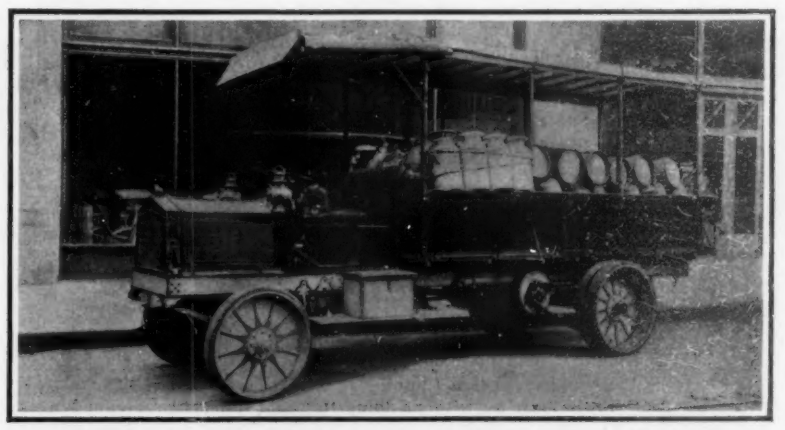


Depositing loads of lumber at factory site without breaking the loads.



Three-ton White gasoline truck with stake body and steel wheels.

Hauling paving material with a truck fitted with a dumping body.



How general transfer work is done in Cincinnati by three-ton motor trucks.

THE MOTOR TRUCK VS. THE HORSE

A Few Shop Jobs on an Old Car

Hints for the Man Handy with Tools

By Herbert L. Towle

The man who knows how to use his hands and who has a few machine tools at his disposal can do much of his repairing himself. To be sure, there will always be jobs that will require the attention of an expert. For all that, there is no reason why the rapacious garage keeper should be allowed to prey upon automobile owners. The instructions which are here given indicate one way of cutting down expenses in maintenance and repairs. This article tells how the steering gear can be made snug; how leaks in the radiator are cured; how new crank-shaft bushings are fitted; how the wear of pistons and cylinders is remedied; how sagged frames are repaired how loose ball bearings in gear cases are tightened; how cracks in aluminium castings are welded; and how the differential is refitted.

ASIDE from repairing actual breakages, which are not covered in this article, the work of overhauling an old car concerns itself, first, with making good the wear due to use; second, with altering or modernizing certain features, such, for example, as the ignition system, to bring them up to date; and, third, with an intermediate class of repairs necessitated by such things as sagging of the frame or axles, or bends in the steering connections which cause the front wheels to run out of line. In most cases of wear or distortion, the proper remedy suggests itself at once to the experienced shop-man. In many cases, however, the severity of automobile service is such as to require much more careful treatment than would be necessary with other classes of machinery. A few typical instances are noted in the following paragraphs.

MAKING A STEERING GEAR SNUG.

The steering gear is usually the first part of a car to show wear, owing to the violent shocks it must endure, and the necessarily limited sizes of the various bearings. A common fault in old cars is loosening up of the bolts holding the casing at the base of the steering column to the frame. Unless the steering column is well braced to the dash or toe-board, the slightest looseness in these bolts will cause the steering column to shake and the bolt holes to wear large. Tightening up the bolts is but a temporary makeshift. The only permanent remedy is to ream the holes true and fair to the next larger size and put in bolts that are a tapping fit in the holes. It may even be worth while to make special bolts for the purpose from annealed tool steel. A better remedy, where it can be applied, is to brace the steering column. This requires that the dash or toe-board itself shall be rigid. A simple method is to make a brass casting to fit the dash or toe-board, having a cored hole a quarter of an inch larger than the steering column. After being put in place, this casting is heated, and babbitt metal is run in to fill the space around the column. If the outside of the column turns, thin paper must be wrapped around it to give clearance, and the babbitt bearing must be four or five inches long and provided with a grease cup.

In case the steering knuckles are worn loose on their pivot bolts, renewal is easy if the knuckles are bushed. If, however, there are no bushings, the knuckles may be counter-bored and case-hardened bushings driven in. These bushings, of course, should be case-hardened inside only, and copper plated and wrapped with asbestos before baking to prevent their outer surfaces from absorbing carbon. The same treatment may be applied to the ends of the front cross link, or the holes may simply be reamed true and pins made and case-hardened to fit them. If new pins are made, they should be provided with oil covers, or, better, small grease cups, and these should feed to the center of the bearing.

LEAK IN RADIATOR.

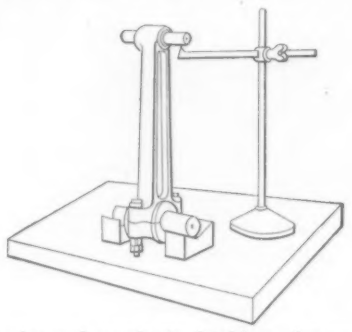
A radiator may be repaired, if the leak is outside, by emptying it and laying it flat so that the solder will not flow away. To prevent adjacent seams from opening from the heat, they may be kept cool with pads of wet waste.

NEW CRANK-SHAFT BUSHINGS.

Die-cast babbitt metal is now almost the universal material for crank-shaft bushings, and is far preferable to bronze. Quite possibly the crank pins of the engine under consideration are oiled by splash from above, through holes drilled in the upper half of the connecting rod "big ends." If so, the repair man has a good opportunity to prolong the usefulness of the next set of bushings by leaving the upper half entirely plain and feeding the oil from beneath by means of copper or steel scoops sweated into the bottom caps of the rods. These scoops should be about one-quarter of an inch inside diameter, and shaped to dip squarely into the oil. Short oil grooves should lead crosswise from the oil hole in the center of the bushing, but these grooves should extend no more than half way to the edge of the bushing, so that the oil will not be able to escape from the bearing without doing its part of the work. In handling connecting rods with scoops fitted, care must be taken not to bend the end of the scoop by an accidental blow, as this would defeat the object of the scoop and result in a cut bearing. The reason for leaving the upper half of the bushing plain is that, under pressure, oil squeezes out from a bearing instead of working into it, and grooves in the pressure side would permit the oil to escape at the very moment when it was most needed.

WEAR OF PISTONS AND CYLINDERS.

The piston rings will become leaky before the pistons have ceased to be a fair fit in the cylinders; consequently, replacement of the rings may be the only

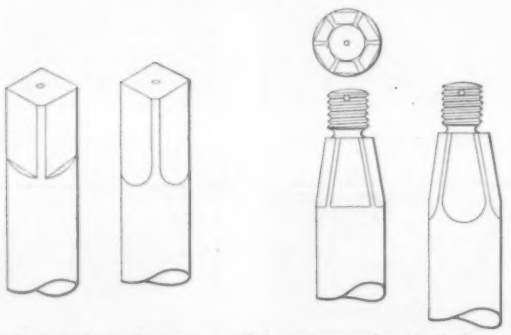


Testing wrist and crank-pin bushings for parallelism after scraping the latter.

thing needed. In time, however, the cylinder wears barrel-shaped, and the piston also wears, with the result of oil working up past the pistons in undue quantities, till a noticeable click is produced at each explosion by the side slap of the piston. When this point is reached, the cylinder must be reground and a new piston turned to fit. The clearance between the piston and cylinder should be approximately one thousandth inch, plus another thousandth for each inch of the piston diameter. That is, a four-inch piston should have five thousandths of an inch clearance. The top of the piston should have, when cold, at least double the clearance given elsewhere, on account of the expansion of the piston head when hot.

SAGGED FRAME.

A motor car frame is after all nothing but a spring, and it sags more or less according to the load. In time the shocks of travel may produce a permanent set in the side members, to compensate for which the motor and gear case should be lined up anew. It is a good plan when doing this to load the frame in some manner to about its normal load. If the sag is small, it can usually be corrected by putting liners under the rear feet of the engine and the front feet of the gear box. Exact alignment is unnecessary if the clutch and gear box are connected by a short shaft having universal joints at both ends. If, however, there is only one universal, or none at all, fairly exact alignment is necessary. An approximate test



Bad and good square and hexagon ends of shafts.

is had by opening all the compression cocks and turning the crank slowly with the clutch engaged to show whether or not there is binding at any point.

If the frame has sagged so much that liners used as above will not correct the trouble, it is best to apply truss rods underneath the frame. The manner of doing this will depend on the room available for attaching the ends of the truss rods and for placing the two struts. According to the size of the car, the truss rods may be from ¾ inch to ½ inch in diameter, and the struts may be from 4 inches to 6 inches high. It is best to attach the ends of the truss rods beyond the spring shackles, and, if possible, over the axles. The struts may be spaced apart about one-third the distance between the ends of the rods. The rivets holding the ends of the rods should be spaced fore and aft and should be about 5/16 inch in diameter, two to four being used, according to the size of the rod. A turnbuckle in the center of the rod will draw the frame straight.

BALL BEARINGS LOOSE IN GEAR CASE.

Annular ball bearings set directly into an aluminium crank case are liable in time to hammer their aluminium seatings until the outer races are distinctly loose. This is avoided in some cars by setting the bearings in bronze cages, thus distributing the contact between the outside of the cage and the aluminium over a larger surface than the outer ball race itself would afford. In case a ball bearing works loose in aluminium, the best remedy is to counter-bore the aluminium about ⅛ inch larger each side, and machine a flanged bronze ring to fit the aluminium as snugly as possible.

FILLETS ON SQUARE-ENDED SHAFTS.

It is quite common for the shafts in live rear axles of the floating type to engage the differential gears by having square bolts milled on the shaft ends. Quite possibly the outer ends of the shafts may engage driving plates in the wheel hubs in the same manner. If the car has side chain drive, the differential shafts may have their inner ends formed in the same way, and the outer ends may have taper ends with hexagonal flats to hold the sprocket pinions. The best modern practice is either to have the shaft enlarged, so that forming a square or hexagonal of it does not reduce its section below that of the end portions of the shaft, or to forge a disk on the end of the shaft with bolt holes or clutch claws on it, the purpose of either construction being to apply the driving force at a greater distance from the center of the shaft. If, however, the shaft is not enlarged, it is very important that the change from the reduced square to full circular section be gradual, not abrupt. An abrupt shoulder at this point concentrates the fiber stress, and results in the shaft eventually breaking under strains which it would have easily endured if large fillets were provided instead of a square shoulder. The same thing applies to hexagonal ends. If the shaft is taken out in the course of overhauling, fillets can easily be put in by means of an emery wheel.

WELDING CRACKS IN ALUMINIUM CASTINGS.

Until recently, it was necessary either to discard a cast aluminium part belonging to the crank case or gear case, in the event of its being cracked, or to rivet a more or less unsightly patch over the crack to close and strengthen it. Nowadays such work is done by oxy-acetylene welding. The process, of course, cannot be described here, but it consists essentially in chipping a triangular groove of the width and depth of the crack, and filling this groove with molten aluminium, flowed into it under the heat of the oxy-acetylene blow-pipe flame. The same process is applicable to repairing cracked water jackets and occasionally cylinders, as well as repairing damage of various sorts to wrought iron and steel. Portable apparatus for this purpose may be had in the market, and should be a part of the equipment of every first-class automobile repair shop.

REFITTING THE DIFFERENTIAL.

The hardest part of the differential to lubricate, and the likeliest, therefore, to wear out soon, is the "spider," on which the four small bevel pinions are carried. The spider is usually case-hardened; the pinions may or may not be bushed. Holes are usually drilled in the pinions, through which oil is worked by the rolling of the teeth. If, however, the user makes the mistake of using grease to lubricate his differential, the repairer is likely to find that the bushings of the small pinions have been cut to pieces, owing to the grease refusing to enter. The journal portions of the spider are also likely to have suffered. If the pinions are bushed, the user is fortunate, for new bushings are easily purchased; and, even if the spider must be ground to true it up, special bushings to fit the new diameter of the spider will not be expensive. If, however, there are no bushings, both pinions and spider must be replaced.

RERIVETING AN OLD FRAME.

Most of the frames made to-day are as strong in the riveted joints as elsewhere. Occasionally, however, one may find a frame which through long service has loosened up its joints and must be reriveted to make it sound. This involves dismantling the entire car and taking the frame close to a forge, as the riveting must be done hot to be secure. Before riveting, the holes should be reamed to make sure that they line up evenly and are the proper size for the rivets selected. The frame members must be carefully cleaned after the old rivets have been cut out, as dirt between the surfaces will spoil the tightness of the job.

TAKING UP PLAY IN SPARK AND THROTTLE CONNECTIONS.

In few cars are the spark and throttle connections so carefully made that they don't work loose after the car has run a few thousand miles. When that point is reached, either the operator must depend on guesswork and knack when running slowly, or springs must be attached to take up the slack and exert constant pressure in one direction. The latter expedient is simple and in most cases sufficient. However, a first-class job can be done at small expense by purchasing the ball jointed rod ends manufactured for this purpose and sold to the trade. These ends are usually made to screw over 3/16-inch rods, or to screw into tubing of the same inside diameter; being of the ball joint type, they are flexible in any direction.

OVERHAULING THE IGNITION SYSTEM.

The winter is the proper time for making any changes which may be desired in the ignition system. The number of reputable high-tension magnetos at present available to the user is sufficient to afford little excuse for disappointment in this important item of equipment. If the price of a high-tension magneto is an obstacle, the user can purchase at a reasonable figure, a battery system of high-current economy and great reliability, which produces a single spark for each ignition and requires only common dry cells as a source of current.

Repainting the Old Car at Home

Suggestions for the Amateur

By Herbert L. Towle

FOR a successful job of repainting, the following conditions are essential:

(1) A surface perfectly free from oil or grease.
(2) A smooth foundation on which to work.
(3) A warm room and perfect absence of dust.
(4) The right sort of brushes.
(5) The right knack in handling the brushes to lay the paint, and especially the varnish, on smooth.

After washing the car, strip it of lamps, horn, speedometer, gas tank or generator, spare tire irons if removable, also the fenders, and any other attachments which would interfere with free use of a brush. Go over the paint surfaces where necessary with clean waste and gasoline to remove every trace of grease and dirt, else the paint will not stick. If some of the old varnish gloss remains, roughen it slightly with the finest sandpaper or with wet powdered pumice on a wet rag. Wipe the pumice off clean, using a toothbrush if necessary in the cracks.

If touching-up and varnishing are all that are necessary, match the color exactly, using a vehicle of one part raw linseed oil to three parts turpentine, and apply as required. Stir the paint thoroughly before using. Wipe the edges of the paint areas smooth with a soft rag. Use a soft, flat camel's hair brush, 2 or 2½ inches wide, with the bristles set in glue, and work it in horizontal strokes. A great deal depends on the handling of the brushes and on laying on the right quantity of material. Too little material or too much pressure causes the hairs to separate, leaving brush marks. Too much material results in sags and runs, especially on vertical surfaces. The best plan is to dip the brush, wipe it out slightly according to the area of surface to be touched up at one dipping, and lay the color on with vertical strokes. After the paint is worked out of the brush, but before the hairs begin to separate, go over the surface again to straighten it, using very light horizontal strokes. Work from the top down where practicable, in order to go over any paint that may have run from the brush. Wipe up fresh drops with a rag if necessary, but carefully avoid allowing drops to fall on freshly painted surfaces.

Clean the brush in turpentine, if it is desired to use it later. Stand or hang it in a covered jar with enough raw linseed oil to cover the bristles.

Let the retouching coat dry over night or longer, and rub it smooth with a slab or rubbing felt soaked in water and dipped in wet pumice. Wash clean and wipe dry. Allow several hours for the water to dry out, and apply to the body and bonnet a coat of rubbing varnish, preferably tinted slightly to match the body shade. Use the softest possible flat camel's hair brush as before, but not the same brush. Choose a warm day or have the garage warmed. To avoid dust, sprinkle the floor freely with wet sawdust and sweep it up. Dust the body before you begin, and shake the dust cloth outdoors—not indoors. Have the garage door shut to exclude dust, and if artificial light is required, use it freely, as otherwise spots may be missed or sags and runs develop without being seen.

The varnish will begin to set very quickly, so that fast work is necessary. When correctly applied, it tends to flow smooth, obliterating the brush marks a few minutes after it is spread. The precautions above mentioned, as to knack in handling and the proper quantity of material to have in the brush, are even more important as regards the varnishing operation. Too little material results in a streaky job. Too much material results in sags and runs, and these runs are troublesome to the beginner for the reason that they do not develop for some minutes after the material is applied, so that they are easily overlooked. The varnish should be laid on quickly with vertical strokes, where the larger surfaces are concerned, and at once straightened with very light and even horizontal strokes. Avoid applying an excess of material in one spot and a deficiency in another. Avoid, also, leaving an unfinished portion and returning to it a few minutes later, as by that time the varnish will have begun to set and will show brush marks when again touched. Take a panel at a time and work from the top down. Glance frequently at the surface varnished a few minutes before, and if a sag or run has started, wipe out the brush and go over it very delicately to straighten it out.

If a run is discovered, wet a rag in turpentine and wipe it off, avoiding a smear, and run the brush lightly over the spot. It is inevitable, however, that brush marks will show somewhat after doing this. Remember that the surface will largely be what the brush makes it, and that too much reliance must not be placed on the tendency of the material to flow smooth.

Clean the brush in turpentine and leave it soaking in turpentine while the rubbing coat is hardening. Give the rubbing varnish a week to harden, and then rub it down with wet pumice, moving the felt back and forth in straight lines—not in circles. This should give a surface smooth enough for the finishing varnish. The same brush can be used for the rubbing and finishing varnish coats, by washing it in turpentine after the rubbing coat and letting it stand with the bristles covered with turpentine. The finishing coat acts under the brush like the rubbing coat. It must be worked rapidly, and brushed straight with a very delicate touch after it has been spread. A warm room and extreme precautions against dust are necessary. Parts such as the mud guards, bonnet, etc., which can be removed and laid approximately flat, will give better results when thus treated, since the tendency of the material to run is greatest on a vertical surface, and negligible on a horizontal surface. The finishing coat, like the rubbing coat, should stand at least a week before using, and it is well to shower it with cold water to harden it before the car is first taken out.

If the car is to be repainted, much work is required, the number of coats and preparatory work depending on whether the color is to be changed and on the condition of the old coat. The standard procedure is to begin by sand-papering all over, and to prime with white lead and any suitable pigment mixed in the proportion of one part of raw linseed oil to three parts of turpentine. After drying, which takes a day or two, the rough spots are filled with putty, which is knifed down as smooth as possible. Allow the putty three or four days to harden, and sand-paper it lightly with medium sand-paper, being careful not to flake it off. Next apply three or four coats of rough stuff, as it is called, consisting of equal parts of dry filler and white lead worked into a stiff paste in equal parts of rubbing varnish and japan, and thinned with turpentine. This rough stuff can be purchased ready mixed. Each coat of rough stuff is allowed a day to dry, and the coats are laid crossing each other to give an even surface.

Next apply a "guide coat" to assist in rubbing down. This coat is prepared by adding a red or yellow pigment to the rough stuff and thinning as required with turpentine. The rubbing is done as above, until a smooth surface is reached. The body is now ready for color coats, of which there should be one and a coat of rubbing varnish, or two color coats, to be followed by one coat of finishing varnish.

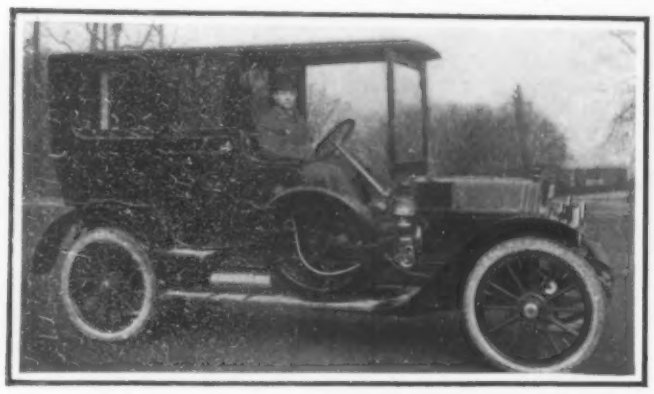
The treatment of the chassis is simpler, as extreme smoothness is not expected. Sand-paper it smooth, putty if necessary, and apply two color coats and finishing varnish as above described. To varnish the wheels, jack them up and take the inner surfaces of spokes, hub, and rim first. After varnishing part of the wheel, give it a half turn to start the varnish in the other direction, thus preventing runs.

The writer has had good success with a painting system prepared and sold especially for amateurs, and consisting of one flat coat, drying in twenty-four hours, a glossy second coat, also drying in twenty-four hours, and the finishing varnish. The first coat in this system is intended merely to give a uniform color foundation, over which to apply the second coat, which is semi-transparent. The final tint, therefore, depends somewhat on the shade of color beneath it. As the first coat does not necessarily match the second coat exactly, and as the system may be applied to change the color of a car completely, it follows that no rubbing can safely be done on either the first or second coats, since if the coat were rubbed through, a different color would show beneath. In case the old surface is in poor condition, or the unpractised hand of the painter leaves noticeable brush marks in the first two coats, the job is improved by one or two coats of tinted rubbing varnish applied after the second coat, and rubbed down smooth. This was used by the writer and the result was very satisfactory.

One thing that the novice cannot do is to stripe successfully. This difficulty is avoided by outlining the dash, fenders, and other parts in flat black, before the finishing varnish is applied. Much or little of this outlining may be done at discretion, but the result is generally best when the outlining is done sparingly. Such parts as the oil lamp and hood brackets can be painted black, and the heads of the hub bolts can be marked with black dots. The flat black is applied with a quill pencil, the surplus material being worked out on a piece of glass or tin. The varnish brush may be cleaned in turpentine and preserved indefinitely in linseed oil for further use, like the paint brush. If a supply of color and varnish is left over, it is very easy to retouch and varnish the car at the end of the season, thus keeping it in good condition for several years.

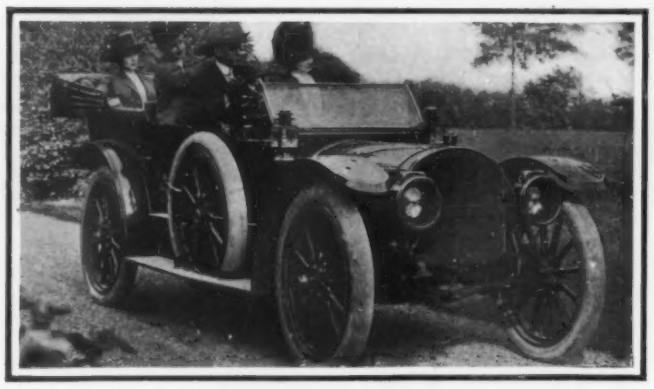
Official Meteorological Summary, New York, N. Y., December, 1910

ATMOSPHERIC pressure: Highest, 30.77; lowest, 29.42; mean, 30.06. Temperature: Highest, 53; date, 3rd; lowest, 9; date, 16th; mean of warmest day, 44; date, 29th; coolest day, 14; date, 16th; mean of maximum for the month, 34.5; mean of minimum, 21.5; absolute mean, 28.0; normal, 34.4; average daily deficiency compared with the mean of 40 years, 6.4. Warmest mean, 42, in 1891; coldest, 25, in 1876; absolute maximum and minimum for 40 years, 68 and —6. Average daily excess since January 1st, 1.4. Precipitation, 1.95; greatest in 24 hours, 0.82; date, 24th. Average for December for 40 years, 3.45. Greatest precipitation, 6.66, in 1884; least, 0.95, 1877. Wind: Prevailing direction, West; total movement, 10,555; average hourly velocity, 14.2 miles; maximum velocity, 61 miles an hour. Weather: Clear days, 12; partly cloudy, 8; cloudy, 11; on which 0.01 inch or more of precipitation occurred, 9. Relative humidity, mean of 8 A. M. and 8 P. M., 67.9. Snowfall, 8.9. Sleet, 28th.



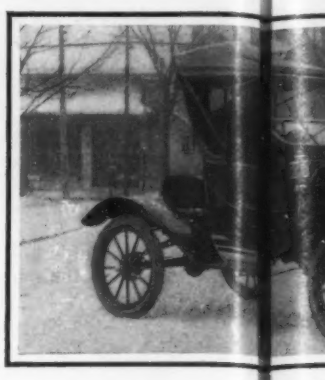
Simplex fifty-horse-power limousine.

Clutch, multiple disk; wheel base, 124 and 129 inches; gage, 56 inches; horse-power, 53; cylinders, 4; bore, 5¾ inches; stroke, 5¾ inches; ignition, high tension magneto; gear changes, four forward, one reverse. Price, $4,200.



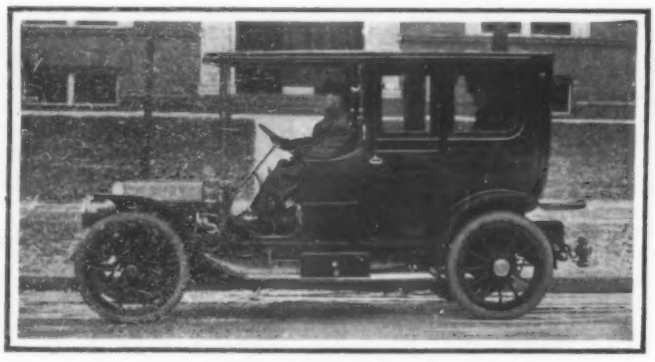
1911 Rambler.

Seating capacity, 5; wheel base, 128 inches; horse-power, 45; ignition, Bosch magneto and storage battery; Stromberg carbureter, cam and cam shaft integral; radiator supported on aluminium girder; trebly reinforced tubular front axle.



Th[illegible]d roads

Seating capacity, 2; clutch, mult[illegible]heel bas[illegible] 22; cylinders, 4; bore, 3½; stro[illegible]ling, wat[illegible] gear changes, tw[illegible]d, one re[illegible]



Peerless town car limousine.

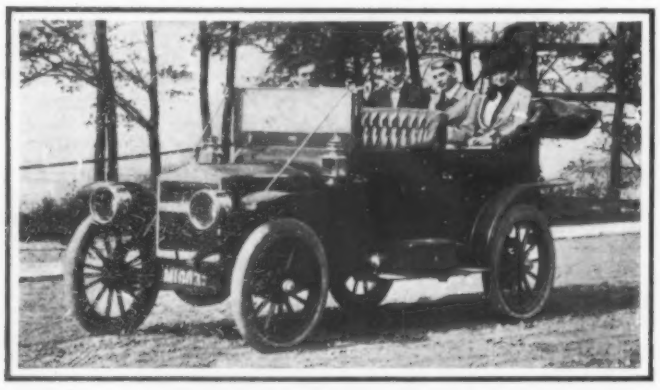
Seating capacity, 6; clutch, expanding band; wheel base, 113 inches; gage, 56 inches; horse-power, 25.6; cylinders, 4; bore, 4 inches; stroke, 4½ inches; cooling, water; ignition, high tension magneto and storage battery; gear changes, four forward, one reverse. Price $4,200.

Cadillac touring car.

Seating capacity, 5; clutch, cone; wheel base, 116 inches; gage, 56 inches; horse-power, 32.4; cylinders, 4; bore, 4½; stroke, 4½; cooling, water; ignition, high tension magneto and Delco system; gear changes, three forward, one reverse. Price, $1,700.

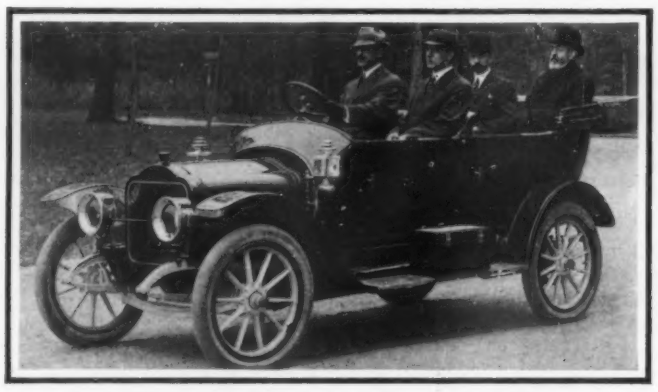
Locomobil[illegible]ing car,

Seating capacity, 5; clutch, cone; w[illegible]120 inche[illegible] cylinders, 4; bore, 4½ inches; st[illegible] inches; [illegible] sion magneto and sto[illegible]ry; drive[illegible]



Maxwell-Briscoe touring car.

Seating capacity, 5; clutch, multiple disk; wheel base, 110 inches; gage, 56 inches; horse-power, 28.9; cylinders, 4; bore, 4¼; stroke, 4¼; cooling, water; ignition, low tension magneto and dry batteries; gear changes, three forward, one reverse. Price, $1,500.

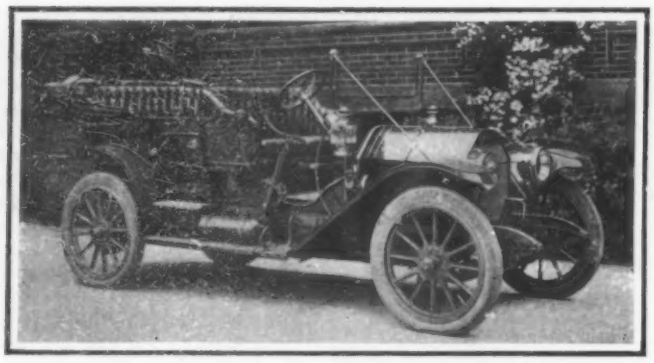


White torpedo car.

Seating capacity, 5; clutch, cone; wheel base, 110 inches; gage, 56 inches; horse-power, 22.5 cylinders, 4; bore, 3½; stroke, 5½; cooling, water; ignition, high tension magneto; gear changes, four forward, one reverse. Price, $2,000.

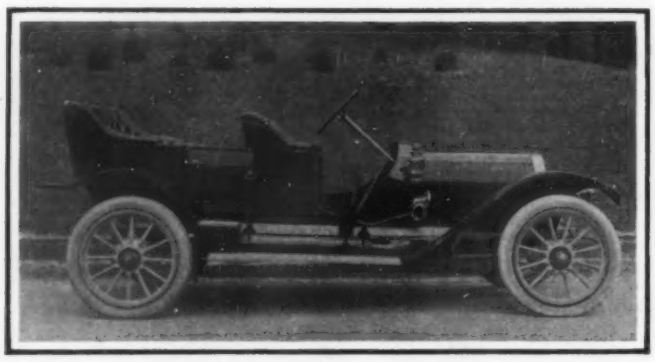
S[illegible]Duryea.

Seating capacity, 5; clutch, m[illegible]ltiple[illegible]heel base, **power, 43.8**; cylinders, 6; bore, [illegible]ke, 4¾; hi[illegible] gear changes, thre[illegible]d, one reve[illegible]



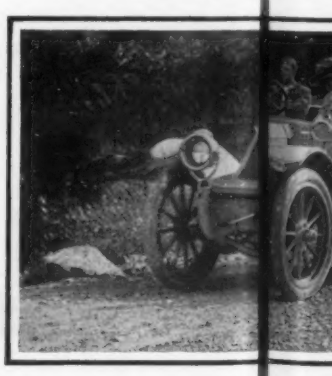
Haynes four-passenger car.

Seating capacity, 5; wheel base, 116 inches; gage, 56 inches; horse-power, 28.9; cylinders, 4; bore, 4¼ inches; stroke, 5 inches; ignition, high tension magneto and dry batteries; gear changes, three forward and one reverse. Price, $2,000.



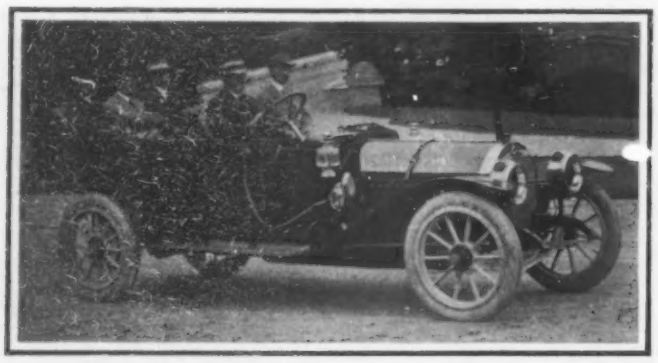
Schacht touring model A A.

Seating capacity, 5; clutch, cone; wheel base, 120 inches; gage, 56 inches; ignition, Bosch magneto; motor, 4-cylinder, 4¼-inch bore by 5-inch stroke; three speeds forward and reverse. Price, $1,385.



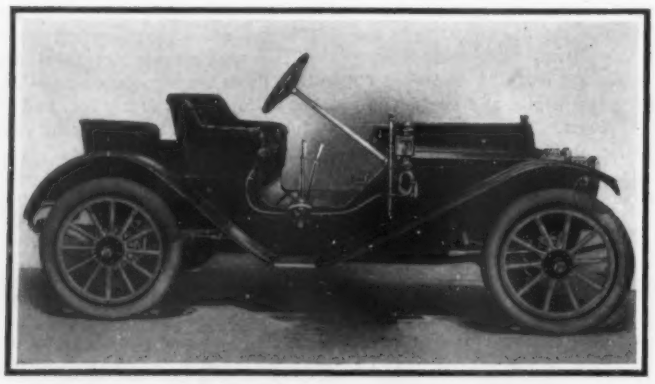
Fr[illegible]torpedo.

Seating capacity, 5; clutch, multiple[illegible]el base, 1[illegible] power, 38; cylinders, 6; bore, 4 in[illegible]ke, 4 inch[illegible] neto; gear changes, th[illegible]d, one rev[illegible]



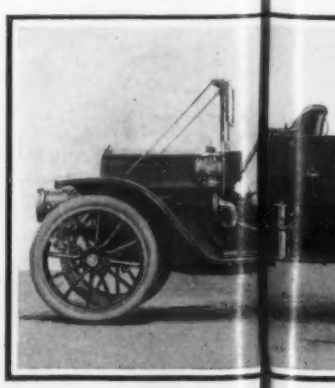
Premier seven-passenger touring car.

Seating capacity, 7; clutch, multiple disk; wheel base, 140 inches; gage, 5[illegible]¼ inches; horse-power, 48.6; cylinders, 6; bore, 4½ inches; stroke, 5¼ inches; ignition, high tension magneto and accumulator; gear changes, three forward, one reverse. Price, $3,500.



Hudson twenty-horse-power roadster.

Seating capacity, 2 or 4; clutch, cone; wheel base, 100 inches; gage, 56 inches; horse-power, 22.5; cylinders, 4; bore, 3¾ inches; stroke, 4½ inches; cooling, water; ignition, dry batteries (magneto extra); drive, shaft; gear change, three forward, one reverse. Price, $1,000.



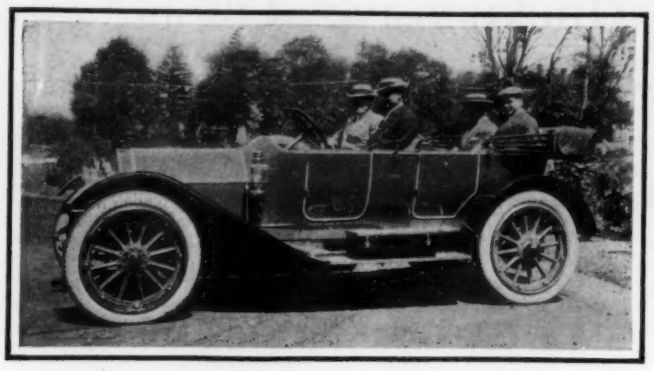
Reo "thirty" [illegible]senger

Seating capacity, 5; clutch, multi[illegible]el base, 1[illegible] horse-power, 25.6; cylinders, 4; [illegible]es; stro[illegible] ignition, low tension magneto a[illegible]teries; driv[illegible] forward, [illegible]. Price, [illegible]

THE CA[illegible] O[illegible]

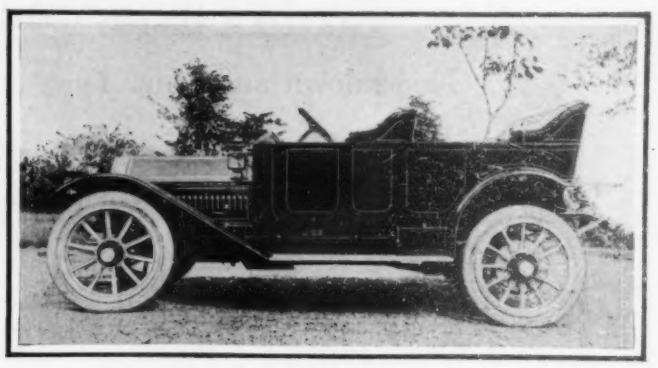
Th roadster.

ipl heel base, 100 inches; gage, 56; horse-power, ro ling, water; ignition, low tension magneto; tw l, one reverse. Price $725.



Chalmers torpedo car.

Seating capacity, 4; clutch, cone; wheel base, 122 inches; gage, 56 inches; hors power, 40; cylinders, 4; bore, 5 inches; stroke, 4¾ inches; cooling, water; ignition, hig tension magneto and storage battery; gear changes, three forward, one reverse. Pr e $3,000.

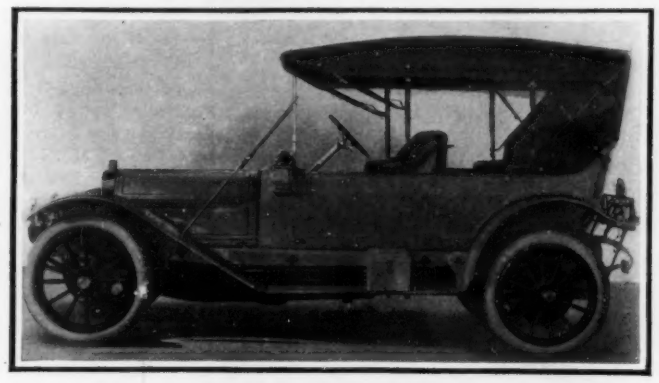


Glide touring car.

Seating capacity, 7; clutch, multiple disk; wheel base, 120; gage, 56; horse-power, 36; cylinders, 4; bore, 4¼; stroke, 5; cooling, water; ignition, high tension magneto and storage battery; gear changes, three forward and one reverse. Price, $2,150.

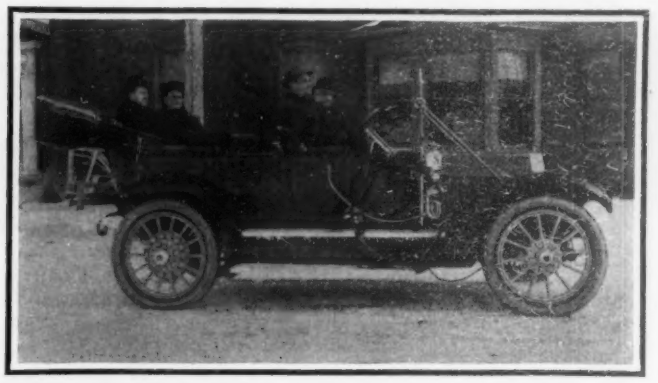
ing car, model L.

120 inches; gage, 54 inches; horse-power, 32; inches; cooling, water; ignition, high ten- ery; drive, shaft. Price, $3,500.



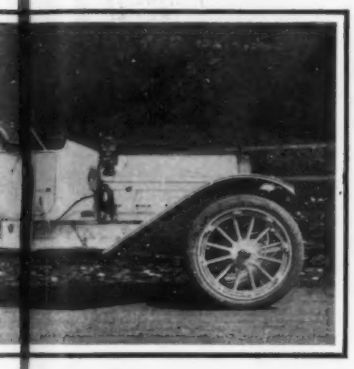
Pierce-Arrow forty-eight-horse-power protected touring car.

Seating capacity, 5; clutch, cone; wheel base, 128 inches; gage, 56 inches; cylinders, 6; bore, 4½ inches; stroke, 5½ inches; cooling, water; ignition, high tension magneto and storage battery; drive, shaft. Price, $5,000.



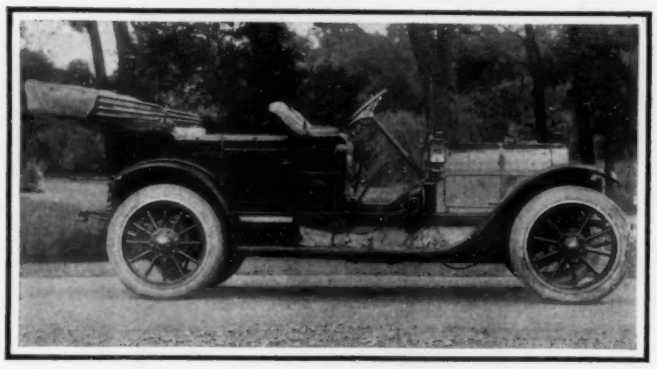
Oldsmobile autocrat touring car.

Seating capacity, 7; clutch, cone; wheel base, 124 inches; gage, 56 inches; horse-power, 40; cylinders, 4; bore, 5 inches; stroke, 6 inches; cooling, water; ignition, high tension magneto and dry batteries; drive, shaft. Price, $3,500.



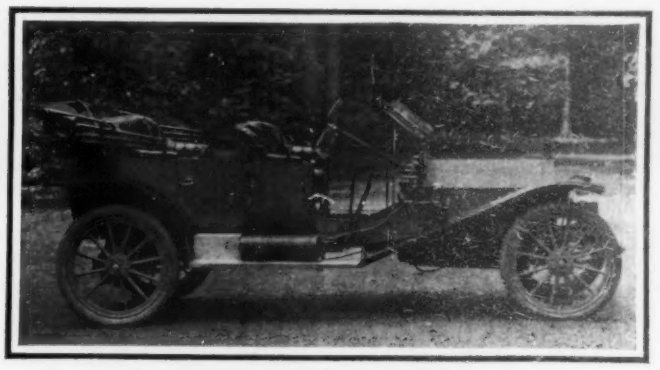
S Duryea.

ipl heel base, 128 inches; gage, 56 inches; horse- re, ke, 4¾; high-tension magneto and battery; hre , one reverse. Price, $3,600.



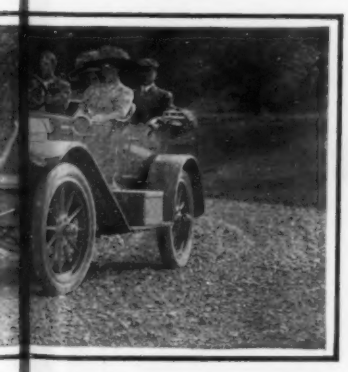
Pope-Hartford five-passenger touring car.

Seating capacity, 5; clutch, cone; wheel base, 124 inches; gage, 56 inches; horse-power, 50; cylinders, 4; bore, 4¾; stroke, 5½; cooling, water; ignition, high tension magneto; gear changes, four forward, one reverse. Price $3,000.



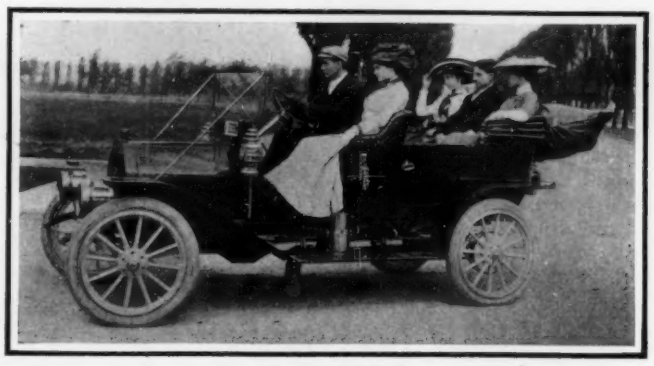
Four-passenger Hupmobile touring car.

Seating capacity, 4; clutch, multiple disk; wheel base, 110; horse-power, 20; cylinders, 4; ignition, Bosch magneto; speed, 40 to 45 miles an hour; transmission, sliding gear. Price, $900.



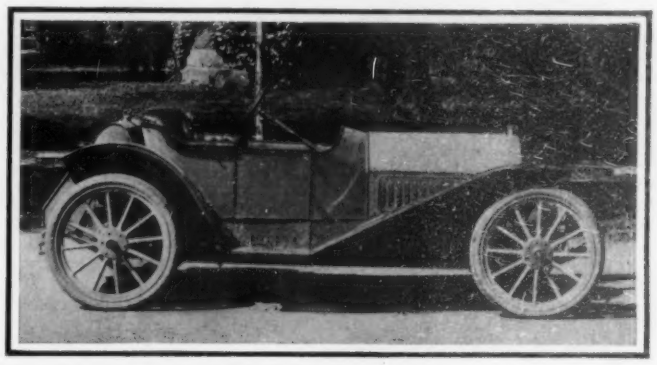
Fr torpedo.

ipl eel base, 133 inches; gage, 56 inches; horse- ke, 4 inches; ignition, high tension mag- th l, one reverse. Price, $3,500.



E-M-F "30."

Seating capacity, 5; clutch, cone; wheel base, 108 inches; gage, 56 inches; horse-power, 25.6; cylinders, 4; bore, 4 inches; stroke, 4½ inches; ignition, high tension magneto and dry batteries; gear changes, three forward, one reverse. Price, $1,000.



Regal, gentleman's roadster.

Seating capacity, 2; clutch, cone; wheel base, 100 inches; gage, 56 or 60 inches; horse-power, 22.5; cylinders, 4; bore, 3¾; stroke, 4½; ignition, high tension magneto and dry battery; gear changes, three forward, one reverse. Price, $900.

enger touring car.

eel base, 108 inches; gage, 56 and 60 inches; ies stroke, 4½ inches; cooling, water; teries; drive, shaft; gear changes, three e. Price, $1,250.

Packard touring car.

Seating capacity, 7; clutch, Packard dry plate; wheel base, 123¼ inches; gage, 56¼ inches; horse-power, 30; cylinders, 4; bore, 5 inches; stroke 5½ inches; ignition, low tension magneto and storage battery; gear changes, three forward, one reverse. Price, $4,200.

Winton limousine.

Seating capacity, 5; clutch, multiple disk; wheel base, 124 inches; horse-power, 48.6; cylinders, 6; bore, 4½ inches; stroke, 5 inches; ignition, high tension magneto and storage battery; gear changes, four forward, one reverse. Price, $4,250.

The Small, Inexpensive Garage

Knockdown and Unit Type of Portable Structures for the Man of Moderate Means

By H. P. Wilkin

It was a foregone conclusion when the first automobile made its appearance that the portable house would be adapted to its needs. There is no necessity for building expensive, elaborately equipped structures for the housing of automobiles, unless, indeed, you have the money to do so. You can buy in the open market for a small sum of money structures that can be set up in a few hours, and that will answer all the needs of a moderate purse. One can afford to be fairly liberal in the matter of size and price when buying a portable garage because he will save the cost of the structure in two years in storage charges that otherwise would go to the public garage.

WITH the increasing use of the automobile it is becoming more and more the custom to house the machine on the premises of the owner, particularly in rural and suburban places, where the owner finds it more convenient and economical to keep the car at home. He saves from $10 to $20 a month on storage and cleaning, knows the car will not be taken out without his permission for "joy riding," and has it always handy for use and inspection, this proximity to the house being an especially desirable condition at the end of a long ride when one wants to get warmed up, washed, and into dry, clean clothes with the least possible delay.

The practice of keeping the car at home is more practical and satisfactory now than in former years, since automobiles have been brought to a degree of reliability and durability that makes frequent and extensive repairing unnecessary. The average owner of a runabout or small touring car finds it no very troublesome task to clean and adjust his car as use and circumstances demand; or, if his premises are large enough to warrant employing a man for general work, the cleaning of the car at least can be delegated to him safely if he possesses ordinary intelligence.

Usually, in suburban places or the outlying residential parts of cities, the distance to a public garage is not great and for that reason there is no need to provide extensive repair facilities in the private garage. They can be of the simplest nature, inexpensive, and occupy very little room—in fact, can be disposed on an ordinary workbench and in a small wall cabinet. Consequently, the structure for housing the automobile does not need to be any larger than will afford protection to the machine and freedom of action for cleaning, oiling, and adjusting it.

There are often numerous objections to building a permanent private garage. The services of an architect might be required, construction might take too long, and the noise and debris of building would be objectionable. More important than these considerations, however, may be the fact that the possessor or intending purchaser of the automobile is only a tenant and does not care to spend several hundred dollars on the construction of a special garage that must be left behind and become a total loss to him in event of a change of residence.

A portable fireproof garage made of metal.

ADVANTAGE OF THE HOME GARAGE.

This situation is very nicely met by the portable or knockdown garage, a construction that has come into widespread and common use among motorists. The advantages of the portable garage are so generally recognized that more than a score of manufacturing companies in the United States have found it worth their while to cater to the wants of automobilists in this line. These are scattered all the way from Portland, Me., to Seattle, Wash., a number being located close to the source of lumber supply in Maine, Michigan, Minnesota and Washington. The great majority of the portable garages are made of wood, although there are several companies that produce such garages of fireproof material, such as galvanized, rolled, and pressed steel. The portable garage is generally used for housing one and sometimes two cars, but it can be bought in a variety of styles and sizes and is, in fact, usually of such construction that the dimensions can be increased indefinitely, at least in one direction, by adding units to the walls and roof. They are so simple to put together, and such explicit directions for erecting are sent to the purchaser when shipping the sections, that expert carpenters do not need to be hired; but when carpenters are hired they can erect the garage in a day or two at an expense of about $25.

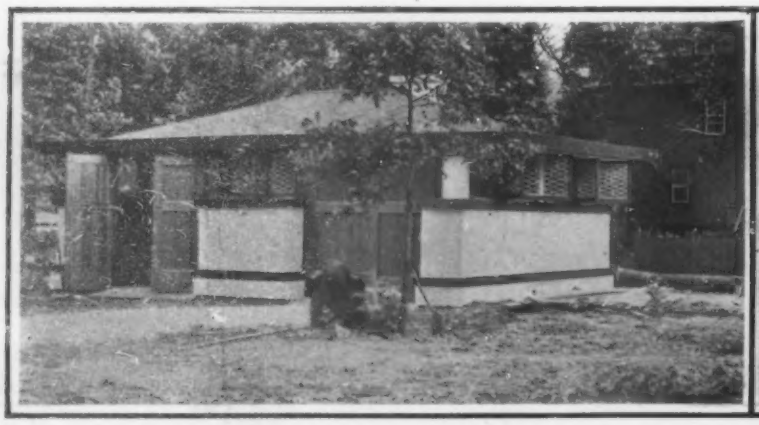
Added to the advantages already pointed out is the fact that the cost of one of these garages, erected and ready for use, is usually considerably less than the cost of building a permanent garage of equal size, serviceability, and appearance. Knockdown or sectional garages can be bought at prices ranging from $135 for one 9 by 13 feet outside measurement, with gable roof, double-hinged doors, and three windows, to $465 for a double or two-car garage of the same construction measuring 18 by 20 feet, fitted with two sets of glass-paneled doors and provided with a sleeping-room 7 by 9 feet for a chauffeur in the rear. Probably the most inexpensive garage is one costing $175, which has dimensions of 14 by 20 feet, gable roof, six windows, double entrance doors, and a side door, a two-foot-wide workbench about 10 feet long, and a five-shelf cupboard with hinged doors. This garage has one coat of priming paint and needs only one finishing coat after it has been erected. Fireproof metal garages 10 by 14 feet, with gable roof, one pair of end doors, one window but no floor, can be bought for $124; or one 16 by 20 feet for $208. The material is galvanized iron and steel, which does not need to be painted unless desired, and the roof panels are fluted and the wall panels embossed.

By way of comparison with these prices, it may be

(Continued on page 51.)

A well-designed concrete garage.

An inexpensive garage of good design.



A small artistic garage of wood and stucco.

Length is more desirable than width.

The Tragic End of Moisant and Hoxsey

How Two Famous Aviators Met Their Death

THE general rush for records by many of the leading aviators during the last days of the year, resulted in two calamities to American aviators in the United States. Two of our most world-renowned and daring airmen lost their lives almost instantaneously, one in the morning and the other in the afternoon of December 31st.

Of the two aviators referred to, the portraits of whom we present herewith, Mr. John B. Moisant was probably the most skilled in the operation, at any rate, of a monoplane, and he had made a reputation in a very few months second to none of the foreign aviators. Starting with his great flight from Paris to London with a passenger in August (which was accomplished after he had been in the machine but thrice before) Mr. Moisant followed this up with numerous thrilling and daring flights at the Belmont Park meet and subsequently throughout the South at a number of prominent cities where he was touring with his foreign associates. The opening day of the meet at Belmont Park he made a successful cross-country flight of about 25 miles in fog and rain, thus demonstrating the capabilities of an aeroplane in bad weather, while the last official day of the meet he made his daring flight to the Statue of Liberty, passing twice over Brooklyn and winning from Grahame-White by but 42 seconds. This race was protested by the English aviator and Moisant had not been awarded the $10,000 prize up to the time of his death. Grahame-White used a 100-horse-power Blériot monoplane and took a roundabout course. Moisant's machine had been damaged by a collision early in the afternoon, but he negotiated with Leblanc, secured his 50-horse-power racer, started off at the eleventh hour, and won the race. Grahame-White was fairly beaten, but he protested on the ground that the race should have been open on the following day, as that was really the last day of the meet. When offered a chance to try again, however, he did not take it.

In his flights in the southern cities Moisant flew with all the abandon of his nature. He was perfectly at home in his Blériot monoplane and never expected to meet death in his machine. At Richmond, Memphis, and New Orleans he made thrilling flights above the cities. At the last-named place he several times ascended to heights of 8,000 or 9,000 feet, and two days before his death he flew for 21 minutes in a 36-mile gale, during which time his machine bobbed about like a leaf in an angry wind, yet without mishap. On December 31st he had arranged to try for the Michelin trophy above a field some ten miles from New Orleans. The course had been marked off, and the officials were on hand early in the morning. Shortly after 9 A. M. Moisant arrived in his machine from the city. A light wind of 12 miles an hour was blowing. He circled the field twice at about 200 feet elevation and then shot down at a sharp angle while going with the wind. When within 75 feet of the ground the angle of descent of the machine suddenly increased to practically 90 deg., or, in other words, the monoplane assumed a vertical position and fell to the ground, striking head-on. Moisant, according to creditable on-lookers, shot out from his machine as from a catapult while it was still in the air and dropping vertically toward the earth. He struck on his head and his neck was broken, so that he died in a few minutes. He was 36 feet away from his machine and in front of it. The machine was not as badly damaged as was one of his other machines in which he plunged to earth at Belmont Park before the meet, and had he managed to keep his seat it is probable he would not have been killed. It is very difficult to explain how he was thrown out of the machine while it was still in the air, and this is the first accident on record in which an aviator has been thrown out unawares.

In the afternoon of the same day, Saturday, December 31st, at Los Angeles, Cal., aviator Archie Hoxsey made an ascent of 7,142 feet in his Wright biplane at the Los Angeles meet. Only a few days before, on the Monday preceding (December 26th), he had made his wonderful new altitude record of 11,474 feet, and almost daily thereafter he had ascended to heights in that neighborhood. Two days before he had passed 4,700 feet above Mount Wilson, making a total elevation of 10,005 feet, and even the day before he had repeated this performance, reaching 10,575 feet. He went aloft on the last day of the year against the advice of other aviators, who found the air full of treacherous currents and whirls. Latham stated afterward that he had never before experienced such dangerous air currents. Hoxsey ascended and performed evolutions for over an hour and reached a height of 7,142 feet. He was descending and had come within 500 feet of the earth when suddenly his machine was seen to plunge downward at terrific speed and possibly to turn over. It struck the ground with a crash and Hoxsey was instantly killed. At the present writing no definite report of this accident has come to hand from reliable witnesses, and the Wright brothers cannot conceive what caused it. Their machine, they claim, is so well balanced that even should the wires that control the horizontal rudder at the rear break, the aeroplane would descend to earth at a good gliding angle and would land without mishap. Whether the accident was due to fancy flying or not, is not known at the present time. Mr. Hoxsey was the team-mate of the late Ralph Johnstone. After Johnstone's death Hoxsey felt that the demonstrating of the Wright machine devolved upon him, and at Denver, on November 19th, he started in an extremely heavy wind and rose to a height of 4,000 feet while traveling toward the distant mountains. When returning he was overtaken by a snow storm, but he landed safely after a 33-minute flight. Previously, at Belmont Park, he and Johnstone had each kept aloft while driven backward across country 25 and 60 miles respectively by a 70-mile gale—a performance which was one of the best of the year, and probably the greatest. He also won the totalization of duration prize at this meet with an actual time in the air of 7½ hours, although he was allowed but 6½. He further secured fourth place in the altitude contest with 6,900 feet to his credit. On October 8th Hoxsey flew across country from Springfield, Ill., to Kinloch Park at St. Louis, a total distance of about 110 miles. He circled above Staunton, Ill., the town where he was born twenty-six years before, *en route*. While at St. Louis Hoxsey took aloft ex-President Roosevelt, on October 27th last, the date of his and the ex-President's birthdays. Hoxsey also held the American record for endurance. This new record of 3 hours and 17 minutes was made at Los Angeles, only a few days before the end of the year.

The loss of these two leading aviators, as well as that of Johnstone, will probably tend to retard aviation in America. Consideration should be taken of the facts, however, that in the cases of Johnstone and Hoxsey the accidents were due, in all probability, to fancy flying and the performing of daring feats, whereas in the case of Moisant the accident was but an illustration of the old saying that "familiarity breeds contempt." Moisant was so thoroughly at home in his machine that he was careless in his manipulation of it and he took chances in alighting with the wind, etc., that no prudent man would take. As far as the use of the aeroplane for legitimate transportation is concerned, it is interesting to note that according to Robert Lorraine, the actor-aviator, who flew across the Irish Sea, but two of the score and a half killed last year met death in cross-country flying. As soon as the gyroscope has been demonstrated on an aeroplane as an effective stabilizer, the average automobilist will be able to use the flying machine almost as readily as he does his automobile.

John B. Moisant in his Bleriot monoplane.

Archie Hoxsey in a Wright biplane.

TWO LEADING AMERICAN AVIATORS WHO RECENTLY LOST THEIR LIVES

Automobile Cylinder Lubricating Oils

What the Automobile User Should Know About Them

By John C. Sparks

THE proper lubrication of the cylinders of automobiles is a subject of great importance to every one who owns or operates a car. In the first place the lubrication has to be accomplished at high temperatures, in a confined space in which an explosion takes place at every fourth stroke of the piston, and the portion of the lubricant that is vaporized on account of the high temperature is violently expelled during the exhaust stroke. A number of suitable methods are used to introduce the lubricant properly, in proper quantities, to the surfaces requiring lubrication, and in this brief article we will consider only the main requirements of a desirable lubricating material, the manner in which it may be tested in a simple way, and a consideration of the conditions under which the work must be done.

Some time ago I made a series of tests on internal combustion engines of the automobile type to ascertain the temperature of the walls of the cylinder and of the piston head. Even where the piston was water jacketed and excess sensible heat removed by this means, the temperature of the walls of the cylinder varied between 550 and 680 deg. F. The heat is quickly removed by means of the circulating water, but is also very quickly applied and re-absorbed by the walls, so that while there are rapid fluctuations of temperature, the fluctuations occur so quickly that practically a constant temperature is maintained. The temperature of the explosion of the gasoline vapors is in the neighborhood of 1,300 deg. F., so that a portion of the lubricant is exposed to this temperature for a short time, and most of the lubricant is exposed to a temperature of from 550 deg. to 680 deg. F. during the time it remains in the cylinder. On this account an oil that vaporizes at a relatively high temperature is required to do this work. It has been found that oils with a flash test, that is to say, the point at which they give off inflammable vapors, of 400 deg. F. maintain their liquid body for a sufficient length of time to perform the lubrication. Therefore one of the first requirements for a suitable automobile cylinder oil is that the flash test shall not be lower than 400 deg. F.

It is usual in describing an oil to mention both the flash test and the fire test, the latter being the temperature at which the oil will give off sufficient vapor to remain continuously alight. As the first test is very dependent on the flash test and is more dangerous to take, I do not think it at all necessary to lay any particular stress on it. In oils of approximately 400 deg. F. flash test, it is usually found that the fire test is from 50 to 60 degrees above the temperature of the flash, and therefore a consideration of the flash is sufficient for the user of the product.

One of the means of estimating the value of an oil for lubrication is to take what is called the viscosity of the oil. The viscosity of any liquid is the relation between the cohesion of the individual particles of the liquid to one another and the adhesion of particles of the liquid to the surfaces with which it may be brought in contact. The viscosity of an oil decreases very quickly when it is raised in temperature, and as all the work done in a gas engine is done at a high temperature, the viscosity should be fairly high at high temperatures.

Viscosity is only a relative means of comparing oils, and as it is not possible for the user of automobile oils to make this comparison at the temperature at which the work is done, it is best to consider the viscosity of an oil at the temperature of boiling water, that is to say, ' deg. F. Other considerations being equal, the oil which at this temperature has the greatest amount of viscosity will probably do the greatest amount of lubrication at the higher temperature under which the work must be done. This consideration has its very distinct limitations due to the fact that the oil when cold must be of such consistency and sufficiently low in viscosity to be easily fed by whatever means of the mechanical system used for introducing the oil into the cylinders. Therefore when comparing the viscosity of an oil at 212 deg. F. it is proper to take into consideration that the oil should not be too viscous at low temperatures. This may be tried out by heating two samples of oil in a water bath until both samples have reached the temperature of 212 deg. F. and then drawing fifty cubic centimeters of the oil into a fifty cubic centimeter glass pipette and observing the number of seconds taken for the oil to flow out of the pipette. This same operation is followed through with the other oil to be compared and an approximate idea of the relative viscosity arrived at.

In the laboratory very much more accurate and careful methods are followed to determine the viscosity accurately, especially to maintain an even temperature and have the test performed under standard conditions with proper apparatus specially designed for this purpose, but the average user of an automobile does not wish to do laboratory tests on oils and wishes to have a fair idea of the subject by practical means.

In addition to the viscosity not being too high at atmospheric temperatures the cold test, or congealing point of the oil, should not be high enough to prevent the oil flowing at winter temperatures. This can be easily checked by placing a small quantity of oil in a four-ounce bottle, inserting a thermometer, placing the bottle in a mixture of ice and salt and observing the temperature at which the oil ceases to flow.

The gravity of oils is an item worth considering, and can be readily ascertained by means of an hydrometer. This test should take place at 60 deg. F., and the specific gravity of the oil should be between 0.870 and 0.900 where water is considered one. One of the first requisites of an oil suitable for this purpose is that it shall be strictly a mineral oil containing no animal or vegetable oils and that it shall be a paraffine base oil and not an asphaltum base oil. This fact leads us to one of the most important considerations of this type of oil, which is that under the conditions existing in an automobile cylinder oil in active operation, as small a quantity as possible of carbon should be deposited when the oil is vaporized. Animal and vegetable oils leave a greater proportion of carbon than mineral oils. Paraffine base oils leave a smaller proportion than asphaltum base oils, and this is the reason of the differentiation given. It is only in recent years that a proper consideration has been given to this subject. In the early days of the automobile one of the main troubles was the covering of the spark plug with carbon and the subsequent failure of the spark plug to perform its work. Nowadays, due to the great improvement that has taken place in this class of oil, trouble from this cause is relatively rare.

Considering only the paraffine base oil, the amount of carbon left on evaporation in the automobile cylinders will vary for different oils. We will consider for a moment the origin and reason for the deposit of carbon. Hydro-carbon mineral oils, as the name implies, consist of hydrogen and carbon combined in varying proportions according to the quality of the oil. In all oils there is, to a greater or lesser extent, a portion of carbon partly or wholly dissociated from the hydrogen. When the oil is heated to a high temperature more of the carbon becomes dissociated from the hydrogen and changes from a liquid, in which form it can be vaporized, into a solid form, in which it cannot be vaporized, and is therefore left behind in the cylinder when the balance of the oil is vaporized and expelled with the exhaust. The carbon thus dissociated is left in the cylinder and collects in small nodules on the piston head, and on account of the high temperature, the nodules will glow and cause premature explosions of the gas vapors.

I first pointed out the necessity of a study of this subject when considering gas engine cylinder oil, and worked out a proper method for performing this test under conditions similar to those which occur in the cylinder when running. Since that time this test has been used generally by manufacturers of this product and has resulted in a great improvement in all the oils used for this purpose. This test is performed at a temperature of about 800 deg. F. by vaporizing the oil in a closed glass container. The container is weighed, a quantity of oil, approximately fifty cubic centimeters, is introduced and again weighed and the heat continued until all the oil is vaporized and the carbon is left in the container. When this weight becomes constant the container is again weighed, and by computing the weight of the carbon left in relation to the weight of the oil taken, the percentage of the carbon on evaporation is ascertained, and an idea as to the quality of the oil from this consideration taken. The Association of Licensed Automobile Manufacturers have recognized the importance of this test, and in their specifications for materials, state that an oil used for gas engine lubrication should not show more than 1 per cent of carbon left on evaporation. This test requires a great deal of care, and I do not see how it is possible to do it except in a laboratory, as the weights have to be determined very accurately and the glass container handled carefully both in applying the heat and in manipulation. I feel that this test is of great importance, and that the user of automobile oils should be informed by the manufacturers exactly what carbon on evaporation is contained in the oil in exactly the same way that other materials used for the manufacture of automobiles are guaranteed to be up to certain definite specifications.

Taking the main points we have considered, an oil suitable for gas engine lubrication should be strictly a mineral oil, free from any animal or vegetable oils, should be a paraffine base oil and not an asphaltum base oil. The gravity can range through a fairly wide degree between 0.870 and 0.900. The flash test, or the point at which the inflammable vapor comes from the oil, should not be lower than 400 deg. F. The viscosity should be relatively high at a high temperature, that is to say, approximately fifty-five seconds by the Saybolt Viscosimeter at 212 deg. F., and should not be too high to prevent the easy flowing of the oil at atmospheric temperatures. The cold test, or congealing point, should not be too high for the same reason. In regard to the carbon left on evaporation, the carbon should not exceed one per cent, and the lower the percentage, when the test is taken under standard conditions, the relatively better is the oil.

The Motorcycles of 1911

THE year 1911 opens for the motorcycle with much promise. The motorcycle seems to have earned for itself a definite place, for we find that it is used by merchants, messengers, rural mail carriers, and even physicians. Naturally these commercial users demand a machine that will be reliable and comfortable, a demand which has brought some of the best mechanical engineers into the motorcycle industry.

As a whole, the machine of 1911 will be heavier than its predecessors. Attempts to employ the mechanical oiler, which met with indifferent success in 1910, are not likely to be repeated. Only two well-known firms will continue to use mechanical oilers.

The low saddle position, the long wheel base, and suitably shaped handle bars will greatly add to the rider's comfort in the machines which will be designed for 1911.

Mechanically interesting in the new models are the absolute control of the motor by turning the grips; ample power at slow speed, so that the machine can travel on crowded streets; free engine devices, which now seem to have been brought to a trustworthy stage; and the elimination of that disagreeable noise which has perhaps, more than any other feature, militated against the motorcycle. A good muffler without a cut-out eliminates this noise, and more than one manufacturer will so equip his machines.

Generous gasoline and lubricating oil capacity is much in evidence in the new models. The result is that the operator is enabled to make long trips without losing time and refilling tanks.

Several types of spring forks have been perfected, with the result that the machine will be more comfortable and will be subjected to less wear.

The transmission is still another important feature that has received attention. With the improved twin roller chain and special waterproof-tanned leather belts that are now being made, transmission troubles are very slight, if any degree of care is exercised in operating the machine. Both types have proved satisfactory and are equally popular.

Extremes of speed, we are glad to note, are not in great demand. Riders are beginning to realize that reliability is of much more importance than speed.

Much attention, states the Railway News, is being paid in Queensland to the linking up of the three trunk lines which form the railway system of the colony. The matter is of great importance to those engaged in pastoral pursuits, and probably is no less interesting to those who may intend embarking in that and other industries, for the linking up would open a lot of rich country. Queenslanders are beginning to realize that the line to be built for linking up purposes should also be a section of the much-talked-of transcontinental railway, and there seems to be no valid reason why it should not be, provided that before the link be built the present Queensland lines are extended still farther westward till well on to the border of the Northern Territory. There are 20,000,000 sheep in the State at present, but were the railway built to Camooweal, this number would be doubled.

(*Continued from page 30.*)

plates, therefore, the height and breadth of the containing jar or "can" are always the same, and the only variation occurs in the width of the container, which must be increased or decreased according to the number of plates in the element. It will be sufficient, therefore, to describe the A-4 cell. There are also manufactured two cells with smaller plates, for ignition and other light work, the B-2 and B-4 cells, rated at 40 and 80 ampere-hours respectively.

The table below gives the dimensions and the output of the three sizes of vehicle cells:

	A-4.	A-6.	A-8.
Outside measurement of can, inches	2 7/8 × 5 1/8 × 12 1/8	3 1/2 × 5 1/8 × 12 3/8	4 1/2 × 5 1/8 × 12 3/8
Height to top of pole, inches	13 3/8	13 3/8	13 3/8
Weight of complete single cell, pounds	13.34	19.00	25.00
Pounds per cell of a Standard assembled battery	14.21	20.09	26.15
Normal discharge rate, amperes	30	45	60
Average voltage at normal rate	1.2	1.2	1.2
Rated ampere-hour output	150	225	300
Rated watt-hour output	180	270	360

In accordance with the low weight of the cell, obtained by the special voltaic combination described, a very light but strong wood battery trap is employed, of skeleton construction and with bent-wood instead of dovetailed corners. An assembled vehicle battery is claimed to weigh not much more than half as much as a lead battery of the same output—a 64-cell battery for a one-ton truck weighing 900 pounds, as compared with 1,550 pounds in a 44-cell lead battery of the same capacity.

The A-4 Edison cell consists of the following parts: The can, a sheet steel receptacle containing the element and electrolyte, and having a top fitted with stuffing boxes for the positive and negative terminal posts, and with a gas valve and filling aperture; the element, consisting of a group of positive plates containing the nickel active material and connected in multiple with the positive terminal by a nickel-plated steel bolt and nuts, the group being intermeshed with a group of negative plates containing the iron active material and similarly connected in multiple and with the negative terminal; and the electrolyte, consisting of a 21 per cent solution of pure potassium hydrate (caustic potash) in distilled water.

The metal of the cell is all nickel-plated iron, so that a pure nickel surface is everywhere presented, protecting the metal from rust or corrosion. The only other visible materal is the hard rubber of the stuffing boxes and the soft-rubber top of the filling aperture. The can is of sheet steel, with corrugated walls to give the greatest stiffness with minimum weight. The seams are welded by the autogenous method, insuring safety from leakage that might otherwise develop from the severe mechanical vibration and shocks which a vehicle battery receives. The can is embossed in places to receive hard-rubber buttons, to maintain a slight separation or air-gap between adjacent cans, and to anchor the can to its proper place on the wood battery tray containing the set of cells.

To the automobile owner the vehicle battery certainly looks good. A compact set of metal cans, with no chance of slopping or breaking. The battery has more the appearance of road service, and smacks less of the electrical laboratory, and this highly mechanical look is justified by the internal construction of the element as a working electrochemical machine. The positive plates, containing the positive or nickel-hydrate active material, consist of a grid of nickel-plated steel, holding 30 little tubes packed with the active material. The grid is a double rectangle in shape, with a center rib, and supports the tubes in two rows of fifteen each, set closely together. The tubes are of very thin sheet steel, perforated with small holes, and packed or "loaded" (very tightly by special machines) with nickel hydrate, interspersed with pure nickel in the form of flakes of extreme thinness. The tubes are formed with a double-lapped spiral seam, and are reinforced by rings or ferrules which maintain internal contact between the nickel hydrate and flake nickel and the internal walls of the tube by preventing bulging of the tube by expansion of its contents. This construction is one of the radical improvements over the old Edison cell. The problem was to bring every part of the hydrate in the plate into active service by insuring permanent electrical contact with its connecting grid, and this result is attained by the thin disks of nickel stacked in the tube in alternation with the layers of hydrate, forming the tube into a mass of intimate physical and electrical contacts between hydrate and nickel and between the edges of the nickel disks and perforated wall of the tube; at the same time permitting intimate contact with the electrolyte in which the tube is immersed, and which seeps in through the perforations. Each of the 4¼-inch tubes in the grid contains about 350 of the tiny nickel disks and their alternating layers of hydrate, so that the maximum distance through which the current has to penetrate, in the charge and discharge of the cell, is only one-half the thickness of the exceedingly thin layer of hydrate.

The thin nickel flake is formed by an ingenious machine which deposits alternate electro-platings of copper and nickel, the copper being dissolved out subsequently. So delicate are the nickel disks cut from this electro-plated sheet that a handful of them is as light as so much feathers.

The negative or iron-oxide plates, of the same length and width as the positive plates, consist of a grid of three rows of eight flat, rectangular pockets, each perforated like the tubes of the positive plate with fine holes to permit contact of the electrolyte with the active material. The latter consists of an iron oxide very similar to ordinary "iron rust," subjected to heavy pressure in the containing pockets, so that each mass of active material is practically integral with the grid.

The plates of each group, positive and negative, are hung on their horizontal connecting rods, with spacing bushings between the lugs of the plates and a nut at each end of the rod. Rising from the middle of the rod is the vertical terminal post, having a taper top for making good electrical contact with the adjoining cell or with the external circuit.

The outer surfaces of the two end plates of the element are securely insulated from the walls of the can by sheets of perforated hard rubber. Rods and cross-pieces of the same material serve respectively to separate adjacent plates of the element and to support the element as a whole above the bottom of the can. It is noteworthy that the element does not have to be supported at a considerable distance above the bottom of the cell, as in the lead storage cell, to prevent short circuiting of the plates by the falling of the active material to the bottom of the jar. In the Edison cell there is little or no loss of active material.

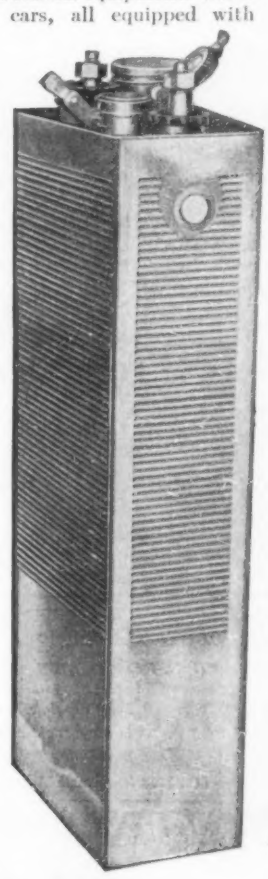
The remaining part of the cell, the top or cover of the can, is welded in place by the autogenous method after the element is assembled in the can. The terminal-post stuffing boxes, the gas valve which separates entrained electrolyte from the spraying of the gas in charging, and prevents it from escaping, and the filling aperture with its automatic spring cap, are water-tight, so as to prevent the leakage of electrolyte in service. The gas valve, by preventing loss of electrolyte during charge, eliminates fuming of the cells, minimizes the amount of filling up for evaporation and renders it unnecessary to add anything but distilled

Re-sales tell the story of superiority of

The New Edison Storage Battery

Whether you are a user or a prospective user of electric vehicles, either pleasure or commercial, read through this chain of evidence:

The Adams Express Company, seven years ago replaced lead battery equipment in four of their delivery trucks, with Edison equipment. Since that time they have purchased over 150 cars, all equipped with Edison Batteries.



Tiffany & Company replaced lead batteries with Edison Batteries in three of their delivery wagons, seven years ago. They have since bought eighteen more cars, all Edison equipped. The Batteries operating these cars have all been in service over a period of from four to seven years.

Hearn & Son, after operating fifteen cars equipped with Edison Battery for three years, discarded lead battery equipment in twelve cars and installed Edison Batteries, making a total of twenty-seven Edison equipped cars.

Frederick Loeser & Company, of Brooklyn, after operating an Edison Battery for one year in one of their vehicles that was made for lead battery equipment, replaced lead batteries with Edison Batteries in six more cars.

The United States Express Company have been operating twenty-five vehicles with Edison Battery for several years.

Abraham & Straus, when they decided to put in motor vehicle equipment, purchased twelve vehicles equipped with the Edison Battery

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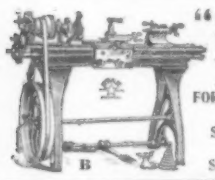

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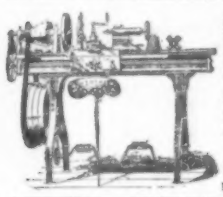

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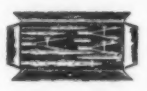

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water during long periods in the life of the cell.

Connections between the cells of a battery and with the external circuit are made by means of heavy nickel-plated copper-wire connectors, with steel lugs swaged on the ends and fitting on the taper terminal posts.

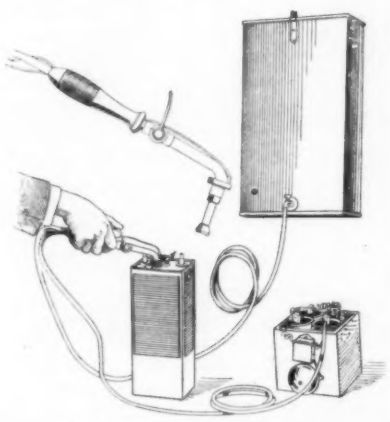
The element is made very compact, with no provision for circulation of electrolyte because the latter is constant, chemically, electrically and physically. In this "can of electricity" the solution is a mere liquid carrier of ions—it has, so to speak, no moods and tenses of its own to be catered to by the battery user. Whereas in the lead cell the constitution (proportions of acid and water), conductivity and specific gravity all undergo definite change during the cycle of charge and discharge, in the Edison cell these qualities remain unaltered. On account of the low voltage of the cell, a vehicle battery of given voltage must contain a larger number of cells than a lead battery, twenty-four lead cells being equivalent to forty of the nickel-iron cells of same ampere-hour capacity; but the low voltage and comparatively high internal resistance are disadvantageous from the purely electrical rather than the vehicle point of view. The cost of charging current, and hence also the efficiency of its recovery in the discharge circuit, is a minor part of the total expense of operating the vehicle; and the low electrical efficiency of the battery is offset by its extremely light weight—which not only lightens the construction of the vehicle, but increases the proportion of "paying load" carried by the same—and by its ruggedness in service. In estimating the true commercial efficiency of a road-vehicle transportation, the ton-miles obtained must be compared with the total cost of operation of the vehicle, with due allowance for all-around reliability. The nature of the support materials and the method of applying the active material to the plates enable the cell to stand dead short circuits without injury. It is stated that the cell improves in use, instead of deteriorating, and the company guarantees to renew any battery at any time for half the cost of a new battery.

In charging, the rate can be varied through a wide range, and may be far higher than would be safe with the lead battery. "Boosting charges"—given a vehicle battery when partially discharged, so as to carry it through a longer period than its prescribed day's work—may be given for an hour's run at a rate two or three times the normal charging rate; and a regular charge may be completed in a hurry by starting at a high rate and gradually decreasing the rate. A vehicle manufacturer using the battery reports that he charged an exhausted battery of A-4 cells at the rate of 100 amperes for a short time, and states that it pays better to put in over

nine-tenths of the normal capacity in a short charge at a high rate than to give the long, slow charge traditionally deemed advisable for lead cells. A commercial vehicle battery of high capacity will give the best results with a 75 to 80 per cent charge at high rate every day, thereby avoiding the loss of efficiency of charging that comes at the end of a "normal" charge at the prescribed rate. A battery showing about 100 volts when charged can be thrown directly on the 110-volt mains without resistance in series.

It is the discharge performance of the battery, of course, expressed in "miles in the battery," that the auto driver is most interested in. Hill climbing is a favorite test of an automobile power plant, and the performance of the Edison battery in this respect is a good indication of its road ability. An electric pleasure vehicle equipped with the battery, the total weight being 2,387 pounds, has climbed Fort George Hill, a distance of 2,138 feet with 11 per cent grade, twenty-one times on a single charge. Another interesting performance of the battery in city work, on a single 7½-hour charge, is a "run-about" of an hour and a half to two hours every day for seven days. The total weight of the car and two passengers was 2,470 pounds, and a total of 120 miles was made at an average speed of 12.32 miles per hour. The cost of the charge was $1.42, which comes to about 21 cents per day.

The garage work other than charging is simplified by the absence of corrosive



Filling up an Edison cell for evaporation. Fitted with thumb valve and connections to bell circuit.

fumes, the substitution of bolt-and-nut connections for lead-burning, the good retention of the active material by the plates and the absence of "sulphating" and similar troubles, and the non-fragile nature of the cans and elements. It is claimed that a single garage man can readily take care of a very large number of batteries; and in fact the Edison battery is not regarded as very attractive business by the public garages accustomed to doctoring lead cells which have been abused, or worn out, in vehicle service. The cells are filled with electrolyte and assembled in trays before leaving the factory, and the sealed top means that the element is not expected to be meddled with by the user, and reduces his work, practically, to mere supervision of the charging and filling up for evaporation, an external cleaning about twice a year (taking the cells out of their trays and removing dirt from between and underneath the cans, and removing rust, if any), and putting in new electrolyte at long intervals. The cell is able to stand idle for long periods, wholly or partially discharged, without injury, because the non-corrosive material of its plates is immersed in the alkaline electrolyte, the cell being, electrochemically, in a state of stable equilibrium.

The element and its separators fill a large proportion of the cubic contents of the can, and the amount of electrolyte is small, giving rise to a greater tendency to heat suddenly by excessive current than in lead cells. Continuous working at high temperatures has an injurious effect tending to shorten the life of the cell, but a temperature of 100 degrees is not critical. In hot weather an electric fan may be turned on the battery when charging, to keep down its temperature. The metal cans and the small amount of solution invite more rapid chilling in a vehicle standing idle in winter than the heat-insulating hard rubber jars of the lead battery, and is to be avoided by properly inclosing the battery trays, sealing up all holes or openings to avoid the entrance of the cold air. In charging, however, the battery compartment must be left wide open. The small amount of electrolyte and the liability of heating on charge at the high charging rates which are permissible, give rise to another sensitive point in the handling of this type of cell, namely, "low electrolyte," i. e., exposing the tops of the cells, and causing loss of storage capacity. In active service it is necessary to "fill up for evaporation" every few days, using distilled water only (ordinary water, which is more or less impure or which has been aerated by absorption of carbonic acid from exposure to the air, being injurious to the cell), and putting in the water just before giving a charge, to avoid the false level due to gas bubbles in the electrolyte. Since the closed and sealed top of the cell prevents a view of its contents, a special filler is provided by means of which water may be added to the same height in a large number of cells in rapid succession. This filler is connected by a flexible rubber tube to an overhead covered tank of distilled water, and is also wired to an electric bell and dry battery. The filler spout is inserted in the aperture of the cell, and a thumb-valve on the filler is operated to allow the water to flow into the can. The stream of distilled water presents a high resistance in the bell circuit, but when the level of the electrolyte has risen into contact with the end of the spout, the bell rings. It is important to avoid filling the cans too full, for this leaves no room for the gas to escape during charge and the electrolyte is liable to be forced out in bubbles—a cause of low electrolyte.

The potash solution becomes contaminated in time, from impurities that have accidentally gotten into the cell either directly or by way of the filler spout (which may be laid down carelessly on a dirty bench), or by absorption of gases in the garage. It therefore needs to be replaced by fresh electrolyte about once in eight months for a commercial-vehicle battery or once a year for a pleasure-vehicle battery.

Some Mechanical Road Guides

(*Continued from page 33.*)

road maps and guide books is that one must first know his precise location on the road before he can tell when and how to proceed; a mistake of even half a mile in the distance from a given point when making a turn might throw one entirely off the course and cause much trouble.

One card serves for only one route, and if this route is more than 100 miles long but less than 200 miles, the card is reversed and the directions on the back are followed. The manufacturers of the instrument supply cards covering all known touring routes in the United States, including several transcontinental routes, and also principal touring routes in Europe. About 600 routes are catalogued for this country alone. The cards can be ordered by number as wanted, and kept in good order in a cardboard case furnished by the manufacturer.

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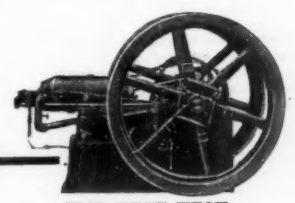

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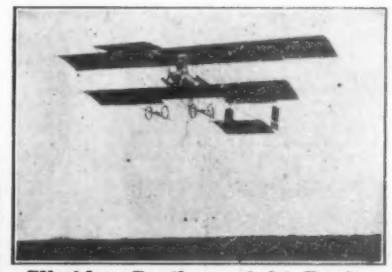

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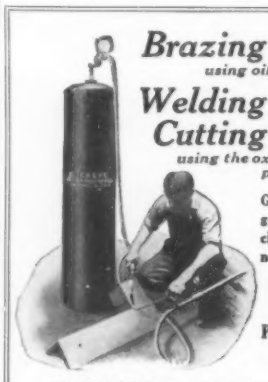

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1611 and 1612—**The Sources of Industrial Alcohol,** that is the Farm Products from which alcohol is distilled, are enumerated by Dr. H. W. Wiley, and their relative alcohol content compared.

1627 and 1628—**The Distillation and Rectification of Alcohol** is the title of a splendid article by the late Max Maercker, the greatest authority on Alcohol. Diagrams of the various types of stills in common use are used as illustrations.

1613—**The Uses of Industrial Alcohol in the Arts and in the Home** are discussed.

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the point where the main road is picked up again. To facilitate driving at night, the face of the instrument is illuminated by a miniature electric light attached by a bracket to the side of the case so that it will throw its light on the pointer and card beneath, but cannot shine into the driver's eyes.

The "Live Map" can be attached by a strong bracket to the steering column, or may be secured to the dash or hung in a leather case on the coat rail in the tonneau.

THE CYLINDER CHART.

It is very interesting to observe how a similar result is obtained in an entirely different way in the "Pathfinder" instrument produced by another inventor. This is in the form of a brass cylinder 8 inches long which has attached to it a strong steel clamp by which it is secured to the steering column directly under the steering wheel. On the upper side of the case is a long, narrow slot protected by a strip of glass. Within the case is a telescoping cylinder, the outer or larger tube of which is arranged to be revolved axially by a flexible shaft driven by the front road wheel of the car. On this cylinder is a train of forty mileage bands and the same number of direction bands, all of metal and alternating. Each mileage band represents five miles of travel, and its edge is divided into miles and tenths of miles, plainly indicated. Each direction band, which is of smaller diameter than the mileage bands, is marked on its edge with letters or characters indicating when to proceed straight ahead, when to turn right or left, which fork to take, and so on. These bands serve for any and all routes, being reset by the user for each successive route to be traveled, as will be explained later.

Inside the case is a "finder" carrying a pointer. The finder is caused mechanically to travel as the car advances, from the left to the right end of the slot in the case, moving successively from one pair of mileage and direction bands to the next. At the approach to each turn in the route, the instrument makes an audible signal, and the little red pointer on the finder points to letters on the direction band, giving the next direction to be followed, while marks on the finder coincide with divisions on the mileage band to the right of the direction band showing the exact distance to the next turn. Thus, the driver cannot inattentively pass a fork or turn, as he will be reminded of it before reaching the turning place.

A small electric light is attached to the instrument to light the dial at night, and there is a little clutch within the case operated by a thumb-screw outside, by which the mechanism can be thrown out of operation when making a side trip to permit the cylinder to be turned at will when resetting the instrument. The total of the mileage bands represents a distance of 200 miles, and, according to the number of turns in it, a route of from 50 to 180 miles can be indicated with one setting of the bands.

To reset the instrument for any given route before starting on it, the case is opened and the cylinder removed. The telescoping part is drawn out and the bands all slipped off upon it from the larger portion. They are then reassembled on the outer tube of the cylinder with the marks on each in a certain relation to the others according to a route key that is furnished by the manufacturers of the instrument. This can be done very easily and quickly, but it is hardly necessary to go into an explanation of the precise process here. When the whole route has been transferred to the cylinder in this way the cylinder is replaced in the case and locked by a thumb-screw at the end. The finder and pointer are slid back to the extreme left of the dial and the cylinder is revolved until the line on the finder is directly in line with the first mark or starting point on the cylinder. The clutch is

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LOCAL REPRESENTATIVE WANTED.—Splendid income assured right man to act as our representative after learning our business thoroughly by mail. Former experience unnecessary. All we require is honesty, ability, ambition and willingness to learn a lucrative business. No soliciting or traveling. This is an exceptional opportunity for a man in your section to get into a big-paying business without capital and become independent for life. Write at once for full particulars. Address E. R. Marden, Pres., The National Co-Operative Real Estate Company, 378a Marden Building, Washington, D. C.

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left out of engagement until the car has been driven to the starting point of the route, where it is thrown in and the tour begun.

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Whereas the two instruments described are actuated automatically by a flexible shaft, a third device is operated by the fingers of the driver's right hand. All the mechanism is contained in a cylindrical case 6 inches long and 3 inches in diameter, made entirely of brass and aluminium and moisture proof. This case is riveted to a stout metal bracket intended to be clamped to the steering column just below the steering wheel where it will be directly under the driver's eyes and within reach of the fingers without removing the hand from the wheel. The mechanism consists of two brass reels turned by gears that are controlled by the small wheel at the right hand end of the case. On the reels is wound a strip or sheet of specially prepared paper upon which are printed all the road directions and distances for a given route, and as the route is traversed the paper is unwound from one reel upon the other, much as a roll of films is used in a kodak.

In the upper side of the case is a large glass covered opening through which the directions on the strip can be read. A single strip is long enough to contain all the directions for a route of 250 miles (that most traveled route in America, from New York to Boston, 244 miles, being on one sheet). Yet each direction is printed in a separate paragraph in plain type and with arrows indicating the direction and angle of turn to be made. The paragraphs are spaced well apart and the words well separated. An important feature of the instructions is that each one carries the traveler beyond a turn onto a straight stretch before giving a new direction, whereas the guide books take him to a point and then give new directions, which is sometimes confusing. Distances from the starting point are given in all paragraphs in miles and tenths of a mile, and prominent land marks are mentioned.

The reels and paper strip are easily removable, and can be withdrawn from the right hand end of the cylinder with the operating wheel. A fresh strip bearing directions for another route or a continuation of the same one can be substituted quickly for the used strip—which can, of course, be used again at any time. Attached to the removable mechanism is a small dry battery and a 2½-candle-power electric light. When darkness falls, the moving of a switch on the outside of the case turns on the light which glows behind the translucent paper and brings the printing out in strong silhouette.

Because this guide is not driven from the road wheel, it is necessary to use an odometer in connection with it to show the distances traveled by the car in order that the directions can be followed at the right places on the road.

Prices for the several mechanical road guides described are $75, $60, and $35, respectively, and extra route cards or strips are 25 cents each. With every instrument bought is given a set of directions for a number of tours. In one case the set comprises twelve cards, in another a selection of routes covering 3,000 miles in any section of the country east of Omaha and north of Atlanta, and in a third case the purchaser is given a volume of key routes covering from 30,000 to 75,000 miles.

Why You Can Buy a Good Car for Little Money

(*Continued from page 35.*)

be inserted and to give the same effect as though the operations were being done in the most efficient manner by hand. This same machine can be used for reaming out the valve-pockets of four cylinders at once by substituting reamers in the chucks for the flat-ended tools that fit in the valve slots.

All of the machines and tools so far described are for the rapid manufacture of parts in quantities, but in order to obtain the greatest efficiency from a plant, these machines must be supplemented by a system that provides for the equally rapid disposal of the parts so completed. In other words, the product of the machines must not be allowed to accumulate to such an extent that the tools will be forced to remain idle for any appreciable length of time. In an automobile plant, the only way to dispose of these pieces as they are manufactured is to assemble them into the various parts that go to make up the completed motor car, and this means an assembling system and organization as perfect and efficient as that required in the machine shop proper. Such a system has been carried to so high a state of efficiency in one of the large factories that 35 cars have been completely assembled in one day by a force of 30 men—and that is quick work considering the fact that these cars grew in a single day from the bins in which the smallest parts are kept to the completed machine, ready to race around the testing track.

TEAMWORK THE KEYNOTE OF SUCCESS.

The keynote to this wonderful system is "teamwork," and by so grouping the men that three can work on two cars at once, each knows exactly what he has to do and is able to keep out of the way of the others. Each team of three men continues to work on the two cars until both are entirely completed, and they then devote their energies to the next pair. None of the men needs to step more than three paces from the frames that form the nucleus on which each car is erected, for the proper number of parts for the two machines are supplied by the stock-room attendants, who wheel them in as required in small trucks divided into compartments to accommodate the pieces of various sizes. Differential pulleys that run on an overhead track passing in front of each frame allow heavy parts, such as motors, rear axles, and transmissions, to be set in place easily, and as all parts are practically interchangeable when they leave the machine shop, but very little fitting is required. This is in striking contrast to the old days of the "built-up" cars, when each part had to receive individual attention and to be fitted to its own special place. In the early days of automobiling there were almost as many types and varieties of chassis and bodies as there were users of the cars. One shop might turn out a dozen varieties of chassis, each interchangeable with as many more different kinds of bodies, and the result was that no maker's product could be termed strictly uniform. The production of parts by machine tools, however, has brought about a striking change, and to-day we find the majority of manufacturers confining themselves to two, or at the most, three, sizes of chassis. In some instances the entire plant is devoted to the manufacture of but a single type of chassis, and when this is done, each workman and every machine can concentrate their efforts on the parts of this one product.

Body building is generally considered to be slightly distinct from automobile manufacturing, and although many plants have departments in which this work is done, it is usually classed as carriage maker's art. This fact, however, enables factories that make but one type of chassis to give their customers the choice of several styles of bodies, and in consequence the ordinary observer might consider that this plant was turning out several varieties of completed cars, whereas, in reality, its prod-

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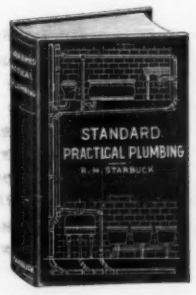

The illustrations, of which there are three hundred and forty-seven, one hundred being full page plates, were drawn expressly for this book, and show the most modern and best American practice in plumbing construction.

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IN the *Scientific American Supplement* we have published in the past few years papers by some of the more eminent physicists and engineers on flying machines. No book thus far published is so complete and so authoritative as these articles. The range of the articles is wide, covering as it does the theoretical side of aviation as well as those more practical aspects which deal with the construction of machines. The following is a partial list of the more important articles which have appeared in the *Scientific American Supplement;* see special note below.

¶ 1816, 1817, 1818, 1819, 1820, 1821 and 1822. **The Practice and Theory of Aviation.** By Grover Cleveland Loening, A. M. This is the most compact paper on aeroplanes that has probably ever been published. Fourteen biplanes and monoplanes are described in detail, and illustrated with scale drawings, namely, the Farman, Cody, Curtiss, Wright, Voisin (old model), Voisin (new model), and Sommer biplanes, and the Antoinette, Santos-Dumont, Bleriot XI, Bleriot XII, Grade, Pelterie and Pfitzner monoplanes. The proper dimensioning of aeroplane surfaces, as deduced by famous experimenters from their tests, is also considered. Taken as a whole this series of seven papers constitutes an admirable text book.

¶ 1713. **The Wright Aeroplane.** This is a thorough description of the old type of Wright biplane with the horizontal elevation rudder in the front of the machine. Excellent diagrams and photographic views accompany the paper.

¶ 1756. **Louis Blériot and His Aeroplanes.** Few people realize that Bleriot's successful monoplane is the result of ten years of daring and perilous experiment. In this paper will be found an instructive description of the evolution of the present successful Bleriot monoplane, illustrated wtih diagrams and photographs.

¶ 1768. **The Farman Biplane.** A complete description of the Farman biplane, with detail drawings of the box tail and vertical rudders, the manner of working the four ailerons, hand and foot levers which control the machine, plan view and side elevation of the entire machine.

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SPECIAL NOTE

¶ We will mail [gratis] a list of many additional important papers, in the *Supplement*, treating of aeronautics. Ask for list A

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uct would be confined to one design of *bona-fide* automobile.

Indications now point to the fact that, in the near future, the manufacture of pleasure cars will be confined to two classes of plants—those for the construction of high-powered cars, and the others devoting their energies to the product of the light, low priced machine. But in addition there are the encouraging present and the tremendous future possibilities open to the commercial car, and it is probable that the same distinctions as those mentioned above will be made in regard to the manufacture of this class of motor vehicles. As machines and tools are introduced that are capable of performing the most efficient work on parts of a certain design or size, the variety of styles and models of cars that can be constructed economically may be said to decrease with the increase of duplicate parts production.

The Motor Truck vs. the Horse.

(*Continued from page 37.*)

Miller gasoline truck in the 3,000 to 6,000 pounds' capacity class won first prizes in the manufacturers' and private owners' divisions with a record of a ton-mile cost for gasoline and lubricating oil of only $0.00765, or slightly more than ¾ of a cent. An Autocar gasoline delivery wagon owned by Wanamaker's department store, was given first prize in the class for 3,000 pounds or less, with an expense for the items named of $0.00898. And a Franklin gasoline air-cooled truck in the manufacturers' division for the same weight class, won first prize with a cost of $0.01285 per ton-mile. A General Vehicle electric truck took first prize in the 3,000 to 6,000 pounds class with an operating cost of $0.007, or 7/10 of a cent per ton mile, and another truck of the same make won first prize in the 3,000 pounds or less class with a current consumption and lubricating oil cost of 1 cent a ton-mile.

The Boston contest, October 21st and 22nd, was to Newburyport and return, through Lowell, Lawrence, Haverhill, Salem, and Lynn, a total distance of 118.7 miles. There were 37 participating machines, of which 32 finished, 24 of them with clean road scores—that is, having maintained the schedule within half a minute. All were gasoline machines. Prize winners were as follows: Warren-Detroit, 1,000 pounds or less, ton-mile running cost, $0.0248; Autocar, 1,000 to 3,000 pounds, ton-mile cost, $0.0103; Franklin, same weight class, ton-mile cost, $0.0068; Frayer-Miller (Kelly), 6,000 to 8,000 pounds, ton-mile cost, $0.0091.

In the New York contest, October 28th to 29th, there were 49 contestants, of which number 26 were gasoline and 23 electric. More than half made perfect road scores and only 6 had any mechanical trouble. The big gasoline trucks in the transfer division were required to cover 65 miles each day, while the gasoline and electric delivery wagons had to cover only 30 or 45 miles, according to classification. A special prize was given an Autocar delivery wagon owned by Wanamaker, which made a record of a total operating cost of only 1 cent a mile per ton carried. A Kelly (Frayer-Miller) gas truck in the 3,000 to 5,000 pounds class showed an operating cost of $0.0086, and a Sampson gas truck in the 5,000 to 6,000 pounds class carried its full load at a cost of $0.0088. A General Vehicle electric truck carried 5 tons throughout the two-days' trial over city and suburban streets at 4/10 of a cent per ton-mile.

In the Chicago trials held the same week, raw, windy weather prevented securing accurate operating cost data by blowing away the confetti that marked the route to Milwaukee and back, so that some of the drivers lost the road, one driving as much as forty miles farther tnan the length of the course. However, there were 51 contesting vehicles, ranging in capacity from 500 pounds to 3 tons. All were loaded to full catalogue capacity. Only gasoline cars competed, and of these 45 reached Milwaukee on schedule time and 40 got back to Chicago within the time allotment. There were 13 perfect road scores. A Brush package delivery wagon carrying 536 pounds, and a Gramm truck carrying 6,200 pounds both made clean road scores and passed the technical examination at the end of tne test without a single demerit. The distance covered was 108 miles the first day and 104 miles the second day.

The foregoing contests serve not only to show the interest taken in this subject, but also how the vehicles can be depended upon to get there and back over considerable distances on city and country roads and about what the running cost is for fuel or current consumption and lubricating oil or grease.

Another notable indication of interest and activity is the plan for the national automobile shows this winter. In New York at Madison Square Garden, in Chicago at the Coliseum, and in Philadelphia the shows will continue for two weeks, the second week in each city being devoted to an exhibition of commercial motor vehicles. The biggest and most representative display of these machines will be the one in Chicago, at which forty-six manufacturing concerns or selling agencies will make displays during the week from February 6th to 11th. The second largest will be in New York at Madison Square Garden, January 16th to 21st, at which there will be 34 exhibitors of commercial vehicles. The exhibition in New York at Grand Central Palace, December 31st to January 7th, allotted space to one-half as many commercial vehicle makers as to pleasure car manufacturers.

It would require volumes to tell of the excellent work that is being done by motor wagons in almost an endless variety of businesses. They are giving satisfaction in many parts of the country in express service, both in the city and between cities; and in the wholesale and retail grocery, meat, drug, beer, mineral water, bakery, produce, drygoods, furniture, piano, clothing, coal, hardware, lumber, and many other trades. All that can be done in the limited space here available for the subject is to give a few concrete examples that show the endurance, capability, and economy of the machines.

A recent evidence of the endurance of the motor truck is furnished by a trip made in October from Detroit to New York by a one-ton Grabowsky truck. The vehicle carried considerably more than its full rated load capacity and three men rode in it all the way. The route was through Canada from Detroit to Niagara Falls, thence to Buffalo, Rochester, and down the Mohawk and Hudson River valleys to the metropolis—a total distance of nearly 1,000 miles as given by automobile route books. The trip was made on 99 gallons of gasoline, 19 pints of lubricating oil, and 7 pounds of grease. The running time was 53 hours, 5 minutes, or an average rate of more than 18 miles an hour. It is said that no repairs were made during the trip, and the only replacement was a spark plug. Following this run, the same machine took part in the commercial vehicle contest in New York, covering 45 miles on two successive days, with 100 enforced stops each day, and finishing with a perfect score each day.

An example of the ability of a motor truck to do work that could not be done at all with horses is furnished by an emergency shipment of motorcycles from Springfield, Mass., to New York during the recent express strike for shipment by steamer to England, where the motorcycles were to be exhibited in the London automobile show. Lack of time prevented shipping by freight, so the twelve machines were loaded on a Knox motor truck and left the factory at 9 o'clock P. M. on October 29th. An all-night stop from 11 P. M. to 7 A. M. was made in Hartford, and on the second day

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the truck reached New York city at 5 P. M. The distance covered was about 150 miles, and the average rate of travel was 15 miles an hour. The only delay was caused by the sinking of a wheel in soft sand at Windsor, Conn., requiring a jack to extricate it.

Again, during the military maneuvers at Chickamauga from June 27th to July 31st last year, a White gasoline truck of 1½ tons' capacity carried supplies and ammunition from Chattanooga to Chickamauga, eleven miles. Much of the time it rained, yet the machine averaged practically 60 miles a day, moving an average of 8,798 pounds daily. The total mileage for the period of slightly more than one month was 1,826 miles, and the aggregate amount of freight moved, 281,453 pounds. The total cost of the operation was $107.29, covering 210 gallons of gasoline, 27 gallons of oil, tire repairs and depreciation, and miscellaneous items. Based on the performance of this one truck, all the freight that could be moved by the 46 horse and mule teams (15 of them double teams) could be moved by four 1½-ton trucks and six 3-ton trucks. The cost of the operation would be less than half, and the number of men required only one-quarter.

Average results obtained with a number of vehicles in the hands of different owners engaged in various trades and extending over considerable periods give the best basis for arriving at what can be expected by other users. Actual cost records of twenty Chase motor wagons of 500, 1,000 and 1,500 pounds' capacity, as used in Syracuse by as many different lines of business for periods of 6 to 22 months, show an average cost per month for maintenance and repairs, exclusive of tires and batteries, but including repairs due to carelessness and accidents, of $13.25 per month per car. An estimate of the cost per year of running and maintaining one of these wagons, which covers 50 miles a day with a consumption of one gallon of fuel to every 14 miles, is $1.217, figuring depreciation at 20 per cent, repairs at $150, and tires at $50. As compared with this the maintenance of two one-horse wagons, at a total estimated cost of $22 a week, would amount to $2,112. The resultant saving by the employment of the motor vehicle amounts to $895—almost enough to pay for the machine the first year.

A dry goods firm in the hilly city of Allentown, Pa., furnishes the following comparative statement of the cost of using an International auto wagon of 800 pounds capacity, fitted with high wheels and narrow solid tires, for one month, and of doing the same work with two horse-drawn wagons:

MOTOR WAGON.	
Driver's wages	$60.00
Boy's wages	24.00
Gasoline, at 14½ cents	27.69
Oil	7.31
Repairs	9.45
	$128.45

HORSE WAGONS.	
Wages for two drivers	$104.00
Wages for two boys	32.00
Feed, etc., for two horses.	35.00
	$171.00
	128.45
Saved in one month	$42.55

The foregoing showing is the more remarkable because while repairs to the motor wagon are included, no item appears for repairs to the horse wagons or harness or for shoeing. The same firm states that the average cost per month for the motor wagon for fuel, oil, rent, and repairs is $20, as against $50 for feed, rent, shoeing, and repairs for a two-horse service, and that in addition the wages of one driver, $40, are saved.

Two of the most important items in this connection that may be overlooked are that one motor vehicle, if the business done is large enough, can do the work of two or three horse-drawn vehicles, thus effecting a direct saving of the wages of one or two drivers and often of helpers' wages as well, and that the space required for storage is not only reduced this much, but that each motor wagon requires only from one-half to two-thirds the actual space needed for one wagon and one horse and no space is necessary for the storage of bulky hay and feed.

Motor trucks and wagons are built for almost every conceivable purpose for which horses and wagons are used, even for work in farm fields, for road building, hauling milk, ice, household goods, for street sweeping and sprinkling, and many other special purposes. In design and construction they vary as widely as pleasure cars ever did, and in carrying capacity range from the 100 pounds or more that can be carried in parcel delivery tricycles to 7 and 10 tons moved by massive trucks. Speaking very broadly, there may be said to be two standard forms of construction; for the better trucks of 2 and 3 tons and upward, the use of a vertical four-cylinder motor in front, sliding gear transmission, differential countershaft and side chain drive; and for delivery wagons and light trucks of one and 1½ tons capacity, double-cylinder opposed horizontal motors placed either in front under a hood crosswise of the frame, or under the body of the vehicle lengthwise of the chassis. When the horizontal motor is used planetary transmission is frequently employed, with single chain drive to the countershaft, though in some makes sliding gears and shaft drive are employed. Water-cooled and air-cooled and four-cycle and two-cycle motors are used in different makes, each having its advocates.

The Small Inexpensive Garage

(*Continued from page 42.*)

mentioned that a plain frame garage 12 by 18 feet, with hip roof covered with cedar shingles, finished outside in stucco and plastered and whitewashed inside, cost the purchaser $200 when bought with a new house. The cost to the builder is believed to have been in excess of this amount.

METHODS OF CONSTRUCTION.

Different manufacturing companies have different methods of construction, but the underlying idea in all so-called portable garages is that they are ready made and assembled in sections so that they can be easily and quickly put together without measuring, cutting, joining, and nailing, as in the ordinary building. To take a typical example, one company makes all of its portable buildings measuring up to 11 by 15 feet with each side and end wall in one section and each side of the roof in one section. Any one of these pieces can be handled by two men. This method reduces the joints to the least possible number and results in a strong, tight, and weatherproof building. Frames for the wall sections are of 2-inch cypress, with studding placed 14 inches center to center. The corner joints are drawn firmly together with 3-inch lag screws. A special weatherproof lining is stretched over the frame and on top of this is nailed cypress or red cedar siding. Roof sections are made in a similar way, and where they meet at the ridge they are capped with a 3 by 3-inch ridge pole milled out to fit closely over the ridge boards. The rafters are notched at the lower end to fit the top of the side walls and are fastened two feet from the top on the inside with collar beams to prevent spreading of the rafters and scagging of the roof.

The floor is made in several sections, tongued and grooved to fit tightly together when the building is erected. Spruce joints and North Carolina pine ⅞ inch thick are used in the construction, which is built to carry a weight of four tons. Doors are hand-made and hung on 14-inch plate hinges. They are fitted with Yale lock and foot and chain bolts. Windows are hung from the top

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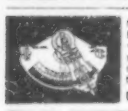

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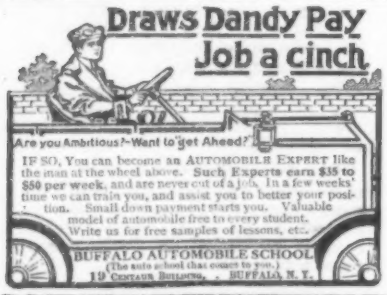

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and swing in or out. Special ventilators carry off the fumes and odor of gasoline. Every garage is painted according to specifications of the buyer, with several coats of good paint. If desired, a pit will be cut in the floor, and on order the garage will be furnished at extra cost with a tool chest, robe rack, and chauffeur's room.

These garages are supplied in several styles, with either gable or hip roof. Sizes range from 9 by 12 feet to 18 by 40 feet, and prices run from $135 to $825. Every garage is guaranteed for ten years. Two or three men with no knowledge whatever of carpentering can put up one of the garages easily by following the directions that come with them, as all sections are marked plainly to correspond to the plans. The only tools needed are a wrench, a hammer, and a screwdriver.

Another type of ready-made garage is furnished "knockdown," completely framed and ready for erection, which costs approximately $25 for carpenter hire. Each piece of lumber is cut to template in the factory and numbered to correspond to numbers shown on the erection plans sent with the material. This material is bundled together and shipped and can be put together by an ordinary carpenter without any difficulty. One priming coat of paint is applied to the lumber.

Hardwood posts 3 feet 6 inches long are furnished to be set in the ground at each point of support for the entrance and girders. There are two lines of girders under the floor to give support directly under the car. Girders, frames, and sills are of large size and the side walls and roof framing are substantial and well braced throughout. All exposed framing is dressed and of select quality of the kind best suited to the particular purpose for which it is used. Wood specially adapted to resist moisture is used for the floor, so that it will dry off quickly after washing the car. Matched siding is put on vertically. The material supplied for the roof consists of surfaced boards to be laid on tight and 16-inch cedar shingles to go on over the sheathing. Any desired style, shape, brand, or arrangement of slate, tin, or composition can be applied, however, to suit any requirement or style of architecture of the residence.

There are six glazed windows, arranged for the best distribution of light for examination of the car and making repairs. They are set in adjusted slides so that they will not rattle and are fitted with strong locks. Besides the pair of entrance doors, which are braced against sagging and provided with heavy hinges, strong bolts and chains, there is a side door near the rear end of the garage, where the workbench is placed. This bench is of good size and has a solid plank top. A commodious tool and supply or parts cabinet is also provided, to be secured against the wall.

Every exposed piece of this garage is given a priming coat of paint before shipment, which makes a good foundation for a subsequent coat of any color the owner may wish. The garage is made in only one size—14 by 20 feet outside measurement—and is delivered completely framed, literally ready to set up, so that about all the work that is required is merely to assemble the large built-up sections and drive a few nails.

FIREPROOF GARAGES OF METAL.

Fireproof metal garages as furnished by two or three companies have undeniable advantages for use in downtown sections of cities where building regulations prevent the erection of wooden structures, and in other locations where the proximity of a wooden garage to frame dwellings would create a fire hazard and increase insurance rates. Like some of the sectional frame portable garages, the metal ones are made on the interchangeable unit plan. Side and end walls are made in 2-foot wide vertical sections and the roof in similar sections. The material is heavy galvanized steel, the side panels embossed and the roof sections fluted in imitation of tiling. No framing whatever is required and no wood is used. The construction is unique and this is believed to be the first strictly fireproof portable garage ever put in the market. By ingenious architectural and structural methods, the siding, roofing, ridges, gables, cornices, sills and tie rods are made to interlock and support one another. All material is shipped in unit sections with patent interlocking edges ready for immediate erection. One or two days suffices for the complete erection by unskilled labor, according to the size of the structure. A common size is 12 by 20 feet, but they are also furnished in 10, 14, 16 and 18 foot widths and in any desired length in multiples of 2 feet, and with side walls 8, 10 or 12 feet high. For motor trucks, side walls may be 12 feet high and entrance doors 11 feet 9 inches in the opening.

Bent galvanized steel anchors provide a foundation that carries angle-iron sills to which the wall panels are attached. Windows and doors have galvanized metal frames. Windows may be inserted in every other panel two feet from any corner and a single door can be inserted in any unit two feet from a corner. Thus the purchaser can vary the size and arrangement within rather broad limits. No floor is furnished except on order and at extra cost, as the floor can be laid in cement, cinders, cement blocks, bricks, or wood, all more cheaply obtainable at destination than if shipped with the garage.

Inasmuch as the material is all galvanized, painting is not essential, but many owners have painted and sanded the side walls to represent stone and painted the roof a dull green to give the impression of a solid stone building with a tile roof.

Prices of these metal garages range from $124 for a structure 10 by 14 feet to $236 for one 16 by 24 feet, and the weights range from 1,860 pounds to 3,540 pounds.

Another type of fireproof steel portable garage has a wood foundation which, however, is embedded in a floor to be laid in concrete, cement, cinders, or asphalt. All of the rest of the construction is metal. The uprights are of iron pipe, the framing of angle-iron, connected by malleable casting and suitably braced, the rafters of T-iron and the roofing of galvanized steel. Sides, ends and doors are also of galvanized corrugated steel. The gables are lighted by small windows hinged at the top to swing in and operated by cords. These garages are made in both gable and flat roof styles, those with flat roofs selling for lower prices than the others.

A combination of wood and iron or steel is employed in some portable garage constructions. One make has foundations of wood, with wall and roof framing of iron pipe and angle iron. The floor is 2-inch hemlock planks, the side and end walls double beaded matched yellow pine and the roof corrugated iron given two coats of paint inside and out. Prices vary from $95 for a 9 by 12 foot to $215 for a 16 by 20 foot garage of this construction.

When considering the purchase of a garage there is danger of figuring too close and making the mistake of getting one that will be found too small. The user may not expect to do much work on the car inside the garage and may plan to do the washing outside, but in winter there will be many times when he will want to tinker with the machine and when the washing cannot be done in the open. During other periods of the year there will be rainy and windy days when the shelter of the garage will be most welcome while small repairs and adjustments are being made. At all such times cramped working quarters become an abomination. There should be at least two feet and preferably three feet

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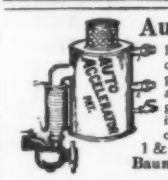

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of working space all around the car, with extra room for the work bench and tool cabinet. The bench is most conveniently located at the rear end of the garage, directly in front of a window. A building 10 by 14 or 9 by 15 is barely large enough to allow space to work around the smallest runabout, and for a small touring car nothing smaller than 12 by 16 feet is to be recommended—12 by 18 or 20 feet is much better.

In this connection it is well to bear in mind that length is more desirable than width, because in the event of getting a new and larger car, the machine is very likely to be longer, but little if any wider than the old one, unless of course a touring car replaces a runabout. In the case of a runabout, the experienced automobilist would recommend getting a garage in the first place that would be large enough to accommodate a small or medium-sized touring car, well knowing that nearly all owners of small runabouts sooner or later replace them with machines of larger capacity and power.

Decorating Madison Square Garden for the National Automobile Show

In the procession of vastly varied events which holds forth in New York's biggest show building, none has yet succeeded in effecting more complete transformations of the interior of Madison Square Garden than the annual automobile shows. While the task of accomplishing this in a new way becomes more difficult each year, the genius of the show managers seem to rise to the occasion. For the forthcoming affair, which for the first time in the history of the Garden shows is to be an exhibition lasting two weeks, from January 7th to 21st, a new precedent for decorative schemes has been worked out. It is said that nowhere in Europe or America has there ever been attempted anything like such an elaborate and artistic creation for an automobile show.

When it is said that more than $45,000 was expended in preparing the setting for the exhibits, only a vague idea is conveyed of what is presented. The motor cars of America's representative makers attract their usual following of the public, but apart from them the scenic surrounding is worth a long trip.

Big gardens and little gardens, aerial gardens and underground gardens, make up the setting for the exhibits. A Roman terraced garden of dignified architectural design constitutes the decorative theme, and serves as a background for the exhibits. There is nothing tawdry or cheap in the decorations, and there is much less ornamentation than heretofore, with a consequent gain of spacious effect and out-of-door feeling. White and gold are the dominant colors in the scheme, although green and crimson are strongly in evidence. The girders of the big dome are screened by a canopy of soft material, rich azure blue in tone, amid which myriad incandescent lamps twinkle. Several massive lamps of rustic construction will be pendant from the roof.

The exhibition spaces of the main floor and elevated platform are covered with a carpet of light green hue which adds to the out-of-door effect. At brief intervals along the aisles of the exhibits of the arena and elevated platforms are ornamental lampposts, finished in verd-bronze, which inform the visitors of the names of the exhibitors and direct them to the various departments of the show.

Along both sides of the arena are richly decorated boxes, which seat about 1,200 people. Extending around all the outer edge of the exhibiting space under the elevated platform, and towering upward to the dome, a series of classic columns lend much to the stateliness of the effect. These are of structural steel, but are so cleverly disguised by lattice work that they appear made of ornate wood. By the use of these columns, and by extending the platforms and balconies, 26,000 square feet of exhibition space was gained for the show. Over two hundred tons of steel and one million feet of lumber were used in reconstructing the Garden interior. Two monster freight elevators were installed to hoist the cars to the galleries. These too escape the notice of the visitor to the show by their ingenious concealment behind latticed effects. Atop of each alternating column is an arbor, in the center of which is the emblem of the show—a wheel surmounted by an American eagle.

There are six staircases leading to the elevated platform. Two of these, in the rear of the interior, can be moved to allow exhibitors to be carried to the elevators.

In the general view there are three balconies in the rear and in the front of the interior, and but two on either side. The foyer of the Garden is decorated as never before. The visitor passes under a big Italian pergola. The walls are harmoniously decorated with posters similar to those used to advertise various automobile sporting events held during the past year.

Nothing more novel has been introduced in decorations than the rustic arbor that hoods the Concert Hall. The woodwork of the arbor is Adirondack silver birch. The counters, pillars, rafters, and lamps are all of rustic construction. Another novel feature is found in the Exhibition Hall, which is transformed into a Roman garden. Here the exhibits appear under a big pergola, twenty feet wide, extending all about the room. The pergola is supported by twenty-five Doric columns and decorated with ornamental foliage. From behind a balustrade the visitor can feast his eyes on a gigantic painting of the Riviera which runs about the walls of the room.

Our Insect-Ridden Timber

Probably one of the greatest troubles that the lumberman and the manufacturer have to contend against is the destruction of wood by insects.

It has been determined by scientists that insects of a certain class attack the wood and bark of living trees; and while they do not contribute materially to the death of the trees, they produce wounds in the bark and wormholes and pinhole defects in the wood, which result in a depreciation in commercial value sometimes amounting to from five to fifty per cent.

Many times these defects are not detected until after the trees have been cut and the logs carried to the mill and have been converted into lumber; and it is not until after the expense of logging and manufacture of the defective wood has been ascertained, that it is known that much of it must be discarded.

According to the scientists, there are several worms, beetles, borers, and weevils that are responsible for this damage, and many others, but those mentioned are perhaps the better known.

The oak timber worm, as its name implies, is probably one of the most destructive of the class just named. Entering as it does through the wounded bark of the oak, or through the bark at the base of broken or dead branches, it extends its "pinhole" burrows in all directions through solid heart wood.

Chestnut timber does not escape, for the chestnut timber worm damages in a like manner all chestnut trees, and it is well known that practically every tree of marketable size is more or less affected, and in some cases, such a large percentage is so greatly damaged that the product is reduced to the lowest grade. This insect does not confine its operations to chestnuts alone, but attacks oaks, and especially the red oak, which they damage as they do the chestnut.

One of the commonest defects in white oak, rock oak, beech, whitewood, or yel-

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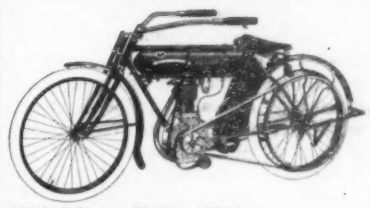

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Note the straight line frame and low, easy saddle position. All the splendid characteristics of the 1910 models are retained, and increased power gained by offsetting the cylinder and increasing the length of the stroke.

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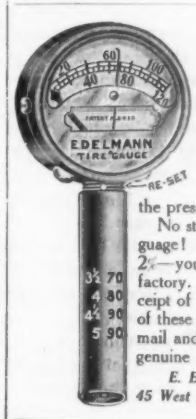

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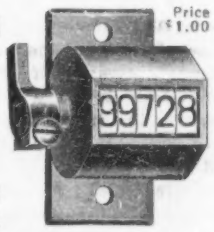

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low poplar, elm, and many other trees, is that known to the lumber trade as "grease spots," "patch worm," and "black holes." This is caused by the timber or ambrosia beetles, which make attacks on the living sapwood from the time the trees are twenty years old until they reach the maximum age. In this way the black and stained wood defect is scattered all through the wood. This defect is also often found in oak and elm furniture and in hardwood finishes in dwellings and other buildings.

Turpentine beetles and borers appear to make a specialty of attacking certain species of pine, the red turpentine beetle operating in the North and the black beetle in the South. They generally attack trees with healthy bark, and often kill areas varying in size from one to ten square feet. These spots are subsequently burned off by surface fires, and are then usually referred to as fire wounds.

White pine trees are also the object of severe attacks by the white pine weevil, and often the value of such trees is reduced from twenty to fifty per cent below those of normal development.

Carpenter worms seem to affect the white and red oak, so much so that holes made by these insects are often over an inch in diameter one way by three-quarters of an inch the other, causing serious damage to the wood.

One of the most profitable trees in the natural forest or on artificial plantations, and one which would contribute largely to an increased timber supply, is the locust; but owing to the ravages made upon it by the locust borer, in many localities the trees are rendered worthless for commercial purposes.

As stated before, there are many other examples of insects which damage the wood and bark of living trees, but those mentioned are sufficient to demonstrate the importance of insects in this relation.

Patents and the Government Employees

The pecuniary benefit to officers and employees of the general government, resulting from inventions useful to and used by the government, has always been a matter of interest to inventors generally. As a matter of fact, the relation of employer and employee in its bearing upon ownership of patents issued to the employee is frequently a very perplexing one. In a report to Congress by the Department of Commerce and Labor, the then Secretary, Mr. Straus, said: "There can be no question as to the wisdom of so treating the employee inventor that he will not be placed in a more unfavorable position with regard to his invention than is the case in private life; in fact, it would seem to be in the best interest of the government, from a purely selfish point of view, to place the employee inventor in a favorable position with respect to valuable inventions and discoveries which he may conceive."

The same report from which the above quotation is made, referring to 253 patents which had been granted to officers and employees of the United States for inventions used by the government, says: "Of this number, approximately 141 have brought no net returns to the inventor, approximately 78 have brought returns to the inventor, and as to the remaining cases, it was impossible to determine definitely whether there had been any remuneration. Some officers and employees of the government have expressly dedicated their patents to the public, while others have dedicated to the government of the United States the rights to make and use the invention. In some other cases, the officers and employees have received large returns.

Ointment for Burns (Lanolin Ointment).—100 parts lemon grass oil, 100 parts lanolin, 15 parts sugar of lead, 2 parts liquid carbolic acid.

Science

A Lottery for Filchner.—The government of Bavaria has undertaken to raise by means of a lottery, the 600,000 marks still needed to defray the expenses of Lieut. Filchner's south polar expedition. An equal amount has already been raised by popular subscription.

A New Star.—We are informed by Prof. Pickering, of Harvard College Observatory, that a new star of the eighth magnitude has been discovered by Rev. T. E. Espin, of Walsingham, England. The star will be known as Nova Lacerta. It was observed visually and photographically at Harvard.

Insurance Against Hail.—The Canadian Province of Alberta continues its popular plan of insuring crops against hail. The latest annual report of the Territorial Department of Agriculture shows that in the year 1909, 246,699 acres of farming land were fully covered by this form of insurance, and 48,732 acres were partially insured. The rate varies from 20 to 40 cents an acre. The total premiums collected, amounted to $84,869, and the total indemnities paid, to $152,060.

A Strange Heat Wave.—A curious heat wave is reported to have passed over Santa Cruz de Teneriffe, Canary Islands, during the night of November 3rd and 4th. At 12:45 A. M. the thermometer at the municipal meteorological observatory registered 63 deg. F.; it then suddenly rose within two minutes to 79 deg. F., and after remaining at the latter temperature for a few minutes fell back suddenly to 63 deg. F. During this time the barograph showed marked oscillations of pressure. No satisfactory explanation of this occurrence has been offered.

A New Aerological Observatory.—It is reported that an aerological observatory will be erected next spring on the Iselberg (altitude 916 meters) by special direction of the Duke of Saxe-Coburg-Gotha. The task of installing this station has been intrusted to the Lindenberg Observatory. It is also expected that an aerological station will shortly be opened on the Feldberg, in the Taunus Mountains, Prussia. These will be important additions to the German network of stations for upper air research. Germany is already far better provided for in this respect than any other country.

Bjerknes on Dynamic Meteorology.—The Carnegie Institution has just published "Dynamic Meteorology and Hydrography," by V. Bjerknes, of the University of Christiania. Prof. Bjerknes is one of the most brilliant investigators in the field of dynamic meteorology, and has recently introduced some promising new methods of research in this subject. It is a fact perhaps worthy of passing notice that Bjerknes's memoir is the Carnegie Institution's first and only contribution to meteorology. The allocation of the institution's funds among the sciences seems to outsiders a trifle capricious, but is possibly a case of "first come, first served."

The Paramoecium.—Of all the minute creatures with which the globe swarms, there is perhaps none more remarkable in certain respects than the paramoecium or "slipper animalcule," as it is sometimes called. The most curious feature in connection with this form of life is the extraordinary rapidity with which it multiplies. By a wise provision of Nature these little creatures soon exhaust their power, generally dying after the one hundred and seventieth generation. Were it otherwise, and the paramoecium family should have a run of luck and the members thereof live to attain three hundred and fifty generations, we are assured that they would crowd every other living thing from the face of the earth and be themselves greater in bulk than the planet itself. Further, should they survive to the nine hundredth generation, it has been estimated that the sun, moon and stars would be floating in a universe of them. The paramoecium is found in stagnant water.

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Because we have brought it to a state of scientific perfection, where its powers are beyond question.

Because we do not sell to anyone until after we have made them *hear*—and without strain or effort.

Because the Acousticon is made by our own experts, from the finest materials procurable—*made to last a life-time.*

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For the convenience of our customers we have offices established in all of the large cities of the United States.

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Men who know all the motor cars around the price invariably choose the Abbott-Detroit.

Motorists who have changed and changed from one car to another for years choose the Abbott-Detroit.

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This Company was not formed with the idea of catching a quick demand and making big profits in a year or so and then quitting.

It was formed for permanence and builds its cars for permanence, not for excessive and quick profit.

Consequently the Abbott-Detroit represents a greater investment of manufacturing capital and labor.

Years have been devoted to the perfecting of every detail, to providing the one perfectly balanced, fully standardized motor car at $1500.

This is why motorists who can tell any motor car a mile away recognize in the Abbott-Detroit many of the features of $4000 motor cars and absolutely the greatest value in a $1500 motor car.

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It shows you this car sells at $1500 fully equipped, while the others sell "stripped" at the price.

It shows you that the "extras" on the other $1500 cars bring their price up to nearly $2000, but that the $1500 price of the Abbott-Detroit includes everything but top and windshield.

When we send the book, we'll send you a letter of introduction to our local dealer, who will show you the Abbott-Detroit and explain its $4000 features.

Dealers writing for territory still unassigned, will be made our regular Agency Proposition.

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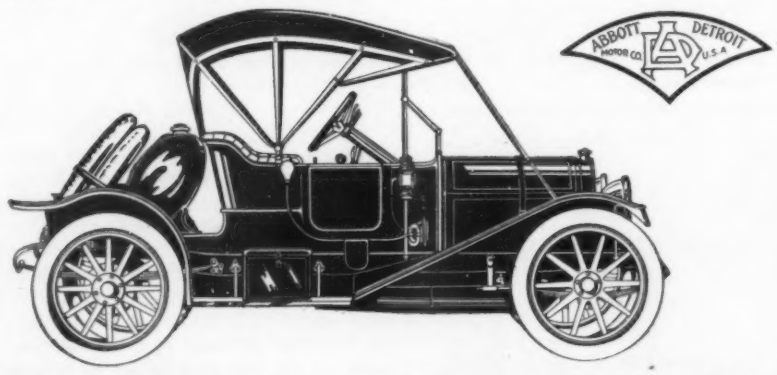

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Electricity

Wireless Telegraphy between Army Posts.—Complete and powerful wireless telegraph stations, have been installed at Fort Omaha, in Nebraska, and Forts Leavenworth and Riley, in Kansas. The War Department has ordered the use of wireless telegraphy in place of line telegraphy hereafter between these posts. It is the purpose of the Department to extend wireless communication to other Western posts, so that they shall not be dependent upon commercial service. Stations are being equipped at Cheyenne and Denver, and others are soon to be installed.

Poles Bought in 1909.—The Census Bureau reports that in 1909 the telegraph and telephone companies, electric light and power companies, and steam and electric railways, spent over $7,000,000 for the purchase of poles. The number of poles bought was 3,739,000. Of these 78 per cent were bought by telephone and telegraph companies. Nearly one-sixth of these poles were subjected to chemical preservative treatment. The number of poles purchased in the previous year was 3,249,000, and of these only one-tenth were chemically treated. By far the greater number of poles in 1909, as heretofore, were of cedar, the number being 2,440,000, while chestnut was the second in the list, with 608,000.

Electricity on the "Olympic."—The electrical power plant of a modern transatlantic steamer is no small installation. The steamer "Olympic" is to be provided with four units generating 2,144 horsepower. This power will be employed in lighting the vessel and for radiators in the first-class quarters; for cooking purposes, for operating various machines, cranes, winches, etc., and for running two passenger elevators and eight freight elevators. The lighting system will total 100,000 candle power. At present, while being fitted up, the vessel is furnished with electric light and power from a 320-kilowatt plant on a tug moored alongside. The tug is also provided with a steam fire pump for use in case of emergency.

Seal for Quartz Lamp Terminals.—Fortunately, the co-efficient of expansion of platinum is very close to that of glass. Consequently, electric lamps which employ a vacuum tube or globe of glass are fitted with platinum terminals fused in the glass. Recently, in mercury vapor lamps quartz has been substituted for glass, so as to permit of higher temperatures and a much higher light efficiency. The expansion of platinum is greater than that of quartz, and hence is unsuitable for such lamps, as the seal is sure to break in a very short time. Instead of platinum, an alloy of nickel and steel, called "invar," has been employed. Although the expansion of this alloy is greater than that of quartz, a tight seal has been effected by giving the wire the form of a conical stopper, and then covering the seal with mercury to provide a hermetically closed joint. A filling of cement prevents the mercury from spilling out.

An "Active-Lamp" Rate.—Residents of Eau Claire, Menominee, and Chippewa Falls, Wis., are being served with electricity on a unique basis. A distinction is made between "active" and "non-active" lamps. Lamps used in main halls and stairways, and in parlors, libraries, dens, music rooms, conservatories and butlers' pantries are classed as "active." All other lamps belong to the non-active class with the exception of one 50-watt lamp on the second floor. Active lights are charged for at 15 cents per month for each 50 watt unit, and in addition to this there is a charge of 3 cents per kilowatt hour on all the service. By this system the use of electricity for cooking and heating purposes or for fans and for power appliances in the kitchen and laundry is encouraged, as power thus employed costs but 3 cents per kilowatt hour.

Engineering

Proposed Pittsburg-Lake Erie Canal.—The long-talked-of scheme for a canal between Lake Erie and Pittsburg is again being revived. The proposed cost of fifty million dollars to be divided between the three States interested, Ohio, Pennsylvania, and West Virginia, and control would be vested in a joint commission.

Locking Car Doors by Air.—What seems to be a practicable invention is a device for locking the doors of English railway cars by means of the air pressure of the Westinghouse air brake. By means of a conveniently located switch, the guard instantly locks every carriage door on the train. Similarly, all doors are kept locked until the train has come to a stop, when they are released by the guard.

To Build 14-Inch Guns at Watervliet.—It is likely that some of the new 14-inch guns of 45 calibers, which are to be mounted on our latest battleships, will be built at the Watervliet arsenal by the War Department. Bids received from private concerns have not been altogether satisfactory, and as the greater part of the Watervliet arsenal is now idle, the time would be opportune for placing a portion of the 14-inch guns at this factory.

Panama Electric Towing Engines.—The Isthmian Canal Commission will shortly advertise for 8,000 tons of material for constructing the tracks upon which will run the massive electrical towing engines which will be built for towing ships through the Panama Canal locks. Ordinary track adhesion would be insufficient for moving a 20,000-ton warship. Consequently, a massive rack rail will be laid between the tracks, into which the locomotive will be geared.

The Ocean Graveyard.—Heavy is the toll taken annually by the sea of British shipping and the foreign vessels sailing near the English coast. Casualties were received by 10,650 vessels during the year, and 4,738 lives were lost. Of vessels belonging to the United Kingdom, 5,276 suffered casualty, and 322 of these were totally lost. The number of seamen and passengers saved from British wrecks, and wrecks of foreign vessels near the British coast, was 7,820.

Curtiss to Train Military Scouts.—According to the Army and Navy Journal, Glenn Curtiss, the aviator, has made a formal proposal to the War and Navy Departments, to instruct a number of officers who may be detailed for the purpose, in aviation, without expense to the government. The training would be done over a mile course, and a special feature would be experiments over water to determine the best methods of rising from and alighting upon the surface.

Dimensions of the "Olympic."—The exact dimensions of the new White Star liner "Olympic," as given out at the time of her launch by the builders, are: Length over all, 882 feet 5 inches; breadth, 92 feet; molded depth, 62 feet; speed, 21 knots, and 34½ feet draft. The tonnage is 45,000, and the displacement 65,000 tons. Corresponding figures for the "Mauretania" are: Length, 790 feet; breadth, 88 feet; molded depth, 57 feet; speed 26 knots; tonnage, 32,000; and displacement, 45,000 tons.

Dreadnoughts of Small Size.—In these days of 32,000-ton dreadnoughts, it is interesting to note how much can be done on a limited displacement, as shown in the case of the three small ships of this type, which are being built for Spain. Though these vessels are of but 14,700 tons displacement, which is less than that of the "Connecticut," they will mount eight 12-inch 50-caliber guns of the most powerful type, and twenty 4-inch guns, and will carry an 8-inch belt tapering to 4 inches at the ends, and they will have 8 inches and 10 inches of armor on the turrets and barbettes. With 1,900 tons of coal, they will have a radius of 5,000 miles at 10 knots.

Take Your Oliver Typewriter --Pay Seventeen Cents a Day!

Send Coupon or Letter for Details

A message of vital moment to the vast audience reached by this magazine.

We are selling the Oliver Typewriter—the Standard Visible Writer—the New Model No. 5—the regular $100 machine—for Seventeen Cents a Day. Whether you sit in the councils of great corporations or are perched on a bookkeeper's high stool—*whatever your part in the world's activities*—this offer of the Oliver Typewriter means something worth while to *you*

Mightiest Machine in World's Workshop

The terrific pace of modern business demands mechanical aids of the highest degree of efficiency. Foremost among all the inventions that speed the day's work—that take the tension from *men* and transfer it to *machines*—is the *Oliver Typewriter.*

The Oliver Typewriter is the mightiest machine in the World's Workshop. It weaves the million threads of the world's daily transactions into the very fabric of business. It works with the smooth precision of an automatic machine. It adapts itself to the diversified needs of ten thousand business conditions.

The OLIVER Typewriter

The Standard Visible Writer

The basic idea upon which its towering supremacy rests is its Wonderful Double Type-Bar. What the Selden patent is to the automobile, this principle is to the typewriter, *only we do not license its use on any other writing machine.*

The Double Type-Bar gives the Oliver Typewriter its positive DOWNWARD STROKE, the secret of *perfect printing, light touch, easy operation and perfect alignment.*

Yours for Pennies! **Send the Coupon**

Having simplified the *typewriter* to the utmost, we have now simplified its *purchase* until you can own it for the trifling sum of Seventeen Cents a Day.

A small cash payment brings you the magnificent new model Oliver No. 5. Then you save Seventeen Cents a Day and pay *monthly* until the machine is *yours.*

No matter what typewriter you are using, you can turn it in as first payment on the Oliver and let *pennies* complete the purchase.

Send coupon or letter for the handsome Catalog and full details of the popular Penny Plan.

Sales Department **The Oliver Typewriter Company**
608 Oliver Typewriter Building CHICAGO, ILLINOIS

Brilliant Exclusive Features

The Oliver is illuminated by scores of brilliant innovations not found on other typewriters. Its remarkable time-saving devices and conveniences include the Vertical and Horizontal Line Ruler, the Disappearing Indicator, the Tabulator, the Back-Spacer, the Adjustable Paper Feed, the Double Release, the Automatic Spacer, the Locomotive Base.

Time and again, when our existing models met every demand of the public, we have brought out important *improvements* at great expense, without adding a cent to the price.

100% Efficiency

The Oliver Typewriter has an efficiency of 100 per cent, every day in the week and from one year's end to the another.

Its printing mechanism works freely in a framework of solid steel, which gives wonderful stability and the limit of durability.

It operates with the lightest touch and thus prevents fatigue. The swiftest operator cannot overtake the speed of an Oliver Typewriter. It writes in beautiful, readable type and, of course, it *writes in sight.*

Every office, whether equipped with one Oliver Typewriter or a battery of Olivers, secures the very maximum of typewriter service at the minimum of cost and labor.

The simplicity, strength and easy operation of the Oliver Typewriter make it most desirable for use in the home.

COUPON

The Oliver Typewriter Company
608 Oliver Typewriter Bldg., Chicago

Gentlemen:—Please send your Art Catalog and details of "*17-Cents-a-Day*" offer on the Oliver Typewriter.

Name .....

Address .....

Every Motorist Needs This Bull Frog Reed

Something new—something practical—the sensation of 1911 in Automobile Horn Reeds. Fits any horn. Produces a prolonged ***musical*** blast instead of usual "honk-honk." It ***warns*** instead of frightens. The vibration of your car cannot loosen it—weather conditions do not affect it, because it's practically indestructible. Sold throughout the United States by leading jobbers and accessory dealers. ***By mail postpaid for 75 cents.*** Order yours today.

GENERAL NOVELTY MANUFACTURING COMPANY
3976 OLIVE STREET ST. LOUIS, MISSOURI

Dixon's Flake Graphite Lubricants

Help you
Help your car

¶ They "made good" as successful lubricants in all kinds of service long before the advent of the automobile and today in automobile work are the established standard with prominent manufacturers.

¶ Dixon's Line of Motor Lubricants are prepared especially to meet the particular requirements of motor car lubrication.

Dixon's Motor Graphite. A selected, finely ground, unctuous flake graphite for general use.

Dixon's Transmission Greases. These come in three consistencies. One is a wood-fibre grease, known as No. 688, that is especially successful in reducing noise.

¶ Remember Dixon and Graphite are synonymous terms. Send for our free booklet "Lubricating the Motor."

JOSEPH DIXON CRUCIBLE COMPANY
JERSEY CITY, N. J.

All Demountable Rims Are Successes In Print
All Demountable Rims Are Reasonably Quick Sometimes

THE
FISK
REMOVABLE RIM

In Actual Service Is
Always Quick—*Always* Safe

It cannot stick because of rust or mud. No short staybolts—No excessive weight—No special tools required.

Mark this: A tire cannot blow off this rim, and there are no loose rings to fly off.

The FISK Rim was the pioneer Demountable. With details perfected, it is the same rim exhibited three years ago. An immediate success, it *is* and *always has been* the only altogether practical rim on the market.

Investigate and Compare Before You Order Tire Equipment,

The FISK RUBBER COMPANY
Department U
Chicopee Falls, Mass.

Twenty Direct Factory Branch Houses.

THE
Adding and Subtracting Typewriter

Is the Model 11

REMINGTON

With Wahl Adding and Subtracting Attachment

This is the complete accounting machine—the machine which writes, tabulates, bills, adds, subtracts and audits—the machine which represents the present acme of clerical labor saving. ***Catalogue sent on request.***

Remington Typewriter Company
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325-327 Broadway, New York, or Any City on Earth

THERMOS

The Necessity For Every Motorist's Comfort

No automobile is completely equipped without Thermos. On the long trip or the short spin Thermos is indispensable for your party's comfort.

Thermos will pay for itself the first trip out.

Thermos keeps any liquid or solid hot without fire or cold without ice until ready for use. Whether you travel or in your everyday life at home, your comfort requires Thermos. It is especially valuable in the sickroom or nursery, and handy in the office or factory.

You cannot appreciate how greatly Thermos adds to your comfort until you read the little thirty-four page booklet full of interesting facts describing every Thermos article herewith illustrated. It is free upon request.

If you are a dealer and not selling Thermos—send for catalogue and discounts.

Thermos is sold by all good stores, but for your own sake avoid worthless imitations. Look for the name "Thermos" on every Thermos article.

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THERMOS BLDG. NEW YORK

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Clinton Wire Lath Is Specified

by the most eminent architects and engineers both for interior and exterior use because of its everlasting permanency and adaptability to the designs of architects.

Plastering supported by it is fire-proof. It is a perfect furring.

Used in the reconstructions of the Fairmount Hotel, San Francisco; used by the United States Government, in the New Memorial Hall at Annapolis; used throughout the country when perfect lathing or furring is desired.

SPECIFY IT. WRITE TO-DAY for descriptive matter

Used in the following buildings

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City Hall, Newark, N. J.
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and thousands of others

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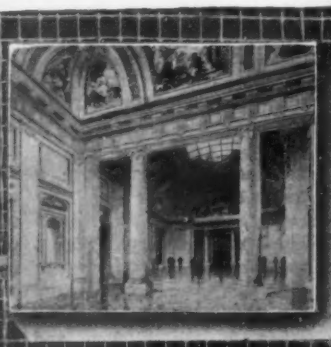

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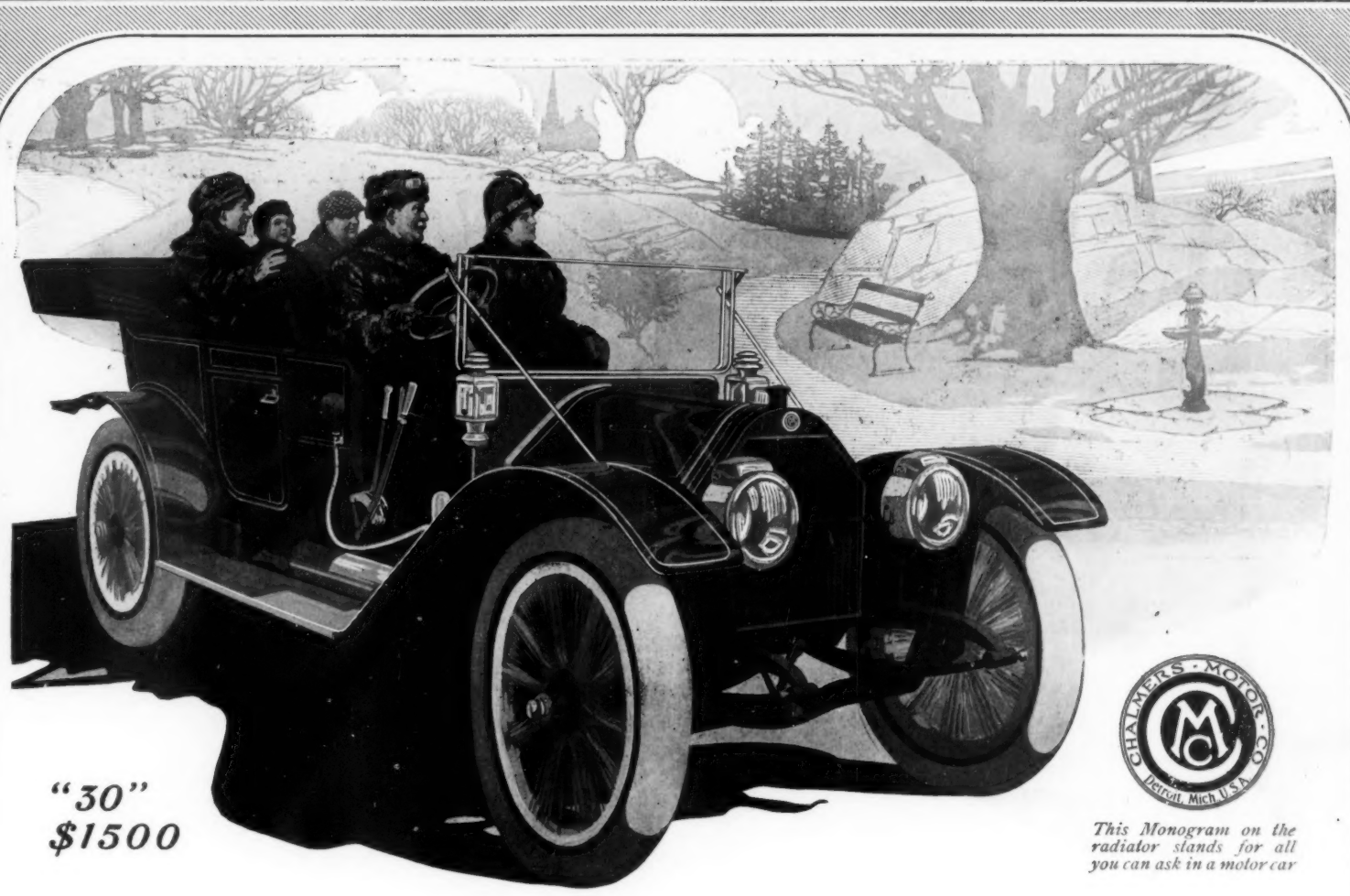


"30"
$1500

This Monogram on the radiator stands for all you can ask in a motor car

Our Guide for Buyers

The season of Automobile Shows is here. An excellent chance for careful comparisons, as the cars stand almost side by side. The multitude of cars and the claims of salesmen are confusing—especially to first-time buyers. So here follow a few points which may be used as standards when selecting and buying.

First, learn if a car has proved itself a good machine, considered purely as a machine. Service in the hands of owners and performance in contests are the only absolute proofs. This test will eliminate some.

There are many good cars nowadays, mechanically considered. After you have settled on several that are, in your opinion, of about equal merit as machines, compare them from other viewpoints.

Beauty first. There is beauty of line and beauty of finish, and beauty in a motor car is deeper than paint. It goes down to the materials and the construction. It means something in addition to eye-delight.

Then look carefully to the matter of comfort—comfort for the passengers and comfort for the driver. Comfort and mere bigness don't necessarily go together.

During demonstrations note how the cars treat you when going over rough spots; note how you feel after riding for an hour in different cars; note whether the seats have springs in them, whether they are tilted; whether the cushion fits your back and shoulders, or not.

Observe the springs on different cars, how they act when called into play. Observe how bodies are suspended, whether they hang between the axles or whether the tonneau seat is high over the rear axle. Note whether the cars are resilient—or harsh.

Sit behind the steering wheels of other cars. Note whether your position there is comfortable—whether the gear shift lever and the emergency brake lever are near at hand or whether you must stoop over to reach them. Note the position of the pedals, of the throttle and the accelerator. And do the same with the Chalmers car.

Look carefully to the four main factors of safety: frame, wheels, steering connections, brakes. You cannot examine these with too much care. Examine the refinements—the wood in dash and door strips and body; the levers, the pedals, the door handles and locks, the floor coverings, foot rests and all the other "little things." See what they are like on other cars. Then on the Chalmers.

Scrutinize the workmanship on the chassis of the Chalmers. Look at the motor, see what a neat, clean job it is. Then note the simplicity in the design of the car from end to end.

Comparison with all other cars has sold more Chalmers than all our advertising.

A feature of our complete exhibits at all leading Automobile Shows this winter will be cut out chassis of the Chalmers "30" with every moving part exposed and in operation. We are proud of every part, so show them all.

There is always a Chalmers dealer near you. He is a busy man, but will always find time to answer with courtesy and integrity all your questions, and to demonstrate thoroughly for you Chalmers cars—"30" $1500; "Forty" $2750. Catalogue "R" on request.

Don't Think Thoughts Six Years Old

Many a business man has said, "I'm not enough of a mechanic to run an automobile, and I can't afford to keep a chauffeur or pay big garage bills to keep my car in order."

The man who says this is thinking in terms of six years ago.

Six years ago such a statement would not have been so far amiss. But the world has moved in six years and the making of automobiles has shown more progress than nearly anything else.

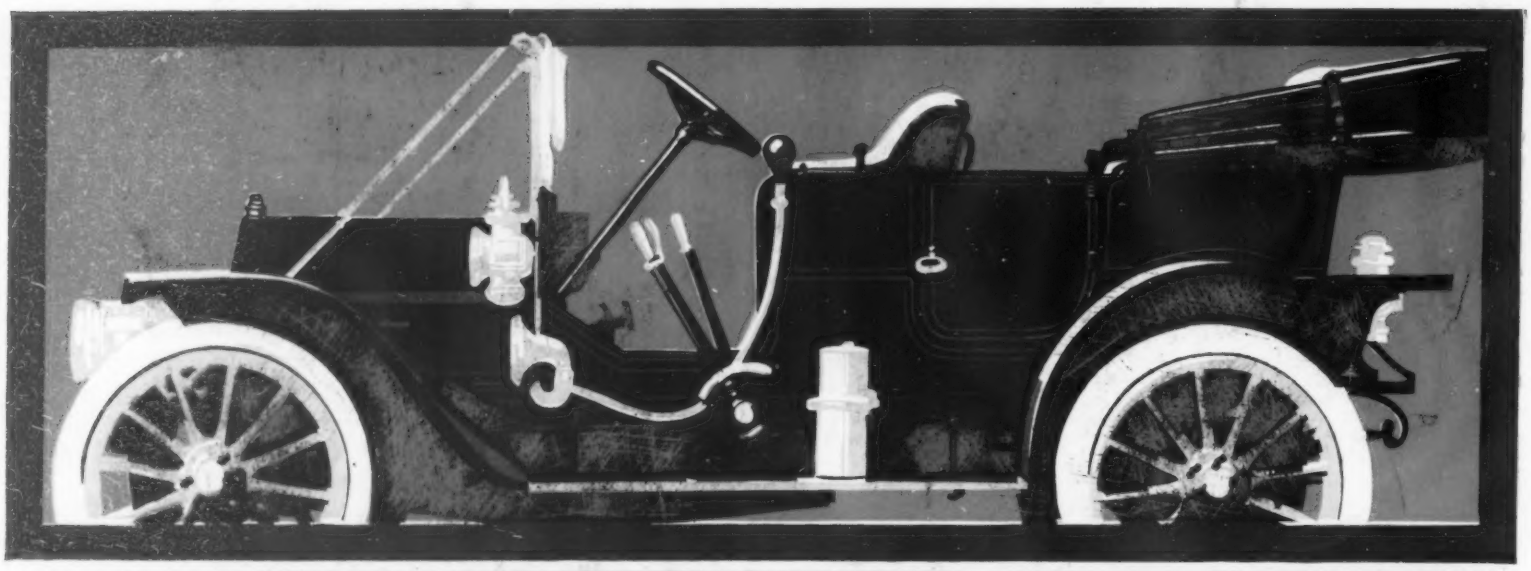
You can buy a real automobile now for as low a price as $1500. It is so simple to operate that you can, and should, drive it yourself. It is so trouble-proof that you won't need to keep it in a garage and have high-priced mechanics tinkering with it all the time.

Six years ago there was scarcely a real automobile to be had at any price. But now—just look around you. See the thousands of men like yourself who use them constantly. Talk to your neighbor who has one. He will give you the straight tip, if you can ever get him to stop enjoying himself in the fresh air long enough to do it.

There are many good cars nowadays, and any good car made by one of the well-established companies is a good investment.

Of course we would like the privilege of showing you the Chalmers before you buy. We know that we have excellent cars, yet if we can't convince you that we offer better value, dollar for dollar, than anyone else, why that is our fault, not yours.

Chalmers Motor Company (*Licensed under Selden Patent*) Detroit, Michigan



REO

New York to San Francisco in 10 Days, 15 Hours, 13 Minutes beating a $4000 Six-Cylinder car by nearly 5 Days

This record is absolute and convincing proof of the value of Reo light-weight construction. It proves:

RELIABILITY. Half of the nearly 4000 miles between New York and San Francisco is desert and mountains—the very worst roads in the country; deep wash-outs, that constantly threatened the life of the car, rocks in the road, often no road at all. And yet the Reo kept to its steady 400 or so miles a day, with not a thing done to the engine the whole trip.

POWER. The Rocky and Sierra Mountains and the desert in between had a lot harder and stiffer climbs than you will ever encounter.

SPEED. In spite of bad roads and not too good weather, the Reo beat the $4000 six-cylinder car by nearly five days.

COMFORT. Human beings could not have endured the strain of that trip, if the car had not the combination of light weight and easy springs which make for extreme comfort in every-day motoring.

This record clears away at one stroke all the imaginary disadvantages of a well designed and well-built light car, and leaves the advantages standing out clear and strong. They are:

Economy
of first cost and operation

Buoyancy
a delightful sensation in motoring

Safety
you can control it more perfectly

Comfort
easy springs because of light weight

Full Use of Power
the easy springs take up the shocks on rough roads

Buy with both sides of your dollar. What ever car you get, insist upon proof somewhere near equal to the Reo's. Buy a certainty, not a chance.

Reo "Thirty" Touring Car or Roadster $1250
Top and Mezger Automatic Windshield, extra

Reo "Thirty" Two Passenger Roadster $1050
Top and Mezger Automatic Windshield, extra

Reo Fore-Door Touring Car $1350
Top and Mezger Automatic Windshield included

Reo "Thirty" Limousine $2000

Send for Catalogue, also "Coast to Coast in Ten Days."

R. M. Owen & Company
Lansing, Michigan

You can do it with a REO

General Sales Agent for
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